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# INTRODUCTION

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The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is used as the authority for the indexing vocabulary that appears in the subject index. The *NASA*

*Thesaurus* should be consulted in examining the current indexing vocabulary, including associated cross-reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the National Technical Information Service or the U.S. Government Printing Office at $8.50 for the three-volume set. The first two volumes of this Thesaurus, consisting of the alphabetical listing of subject terms (A–Z), have been superseded by the following single-volume publication: *NASA Thesaurus Alphabetical Update* (September 1971) (NASA SP-7040), available from NTIS for $6.00. (Volume III of the Preliminary Edition consists of the following ancillary aids to vocabulary selection: heirarchical display of index terms, category term listing, permuted index, and a listing of postable terms only.)

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*Volume 10 Number 12 / June 23, 1972*

# TABLE OF CONTENTS

## Subject Categories

*Abstracts in the journal are grouped under the following categories:*

*page*

**01 Aerodynamics** 1549
Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 32 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

**02 Aircraft** 1550
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc.; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

**03 Auxiliary Systems** 1557
Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

**04 Biosciences** 1558
Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

**05 Biotechnology** 1563
Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

**06 Chemistry** 1565
Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

**07 Communications** 1569
Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

*page*

**08 Computers** 1579
Includes computer operation and programming; and data processing. For applications, see specific categories. For related information see also: 19 Mathematics.

**09 Electronic Equipment** 1585
Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors, integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

**10 Electronics** 1589
Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see specific Physics categories.

**11 Facilities, Research and Support** 1590
Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

**12 Fluid Mechanics** 1594
Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

**13 Geophysics** 1597
Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

**14 Instrumentation and Photography** 1606
Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders, transducers; aerial photography; and telescopes and cameras.

**15 Machine Elements and Processes** 1615
Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; reliability; drafting; and materials fabrication, handling, and inspection.

**16 Masers** 1620
Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State.

**17 Materials, Metallic** 1622
Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

page

**18 Materials, Nonmetallic** 1628
Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

**19 Mathematics** 1630
Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also: 08 Computers.

**20 Meteorology** 1632
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

**21 Navigation** 1637
Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

**22 Nuclear Engineering** 1640
Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

**23 Physics, General** 1642
Includes acoustics, Cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation.

**24 Physics, Atomic, Molecular, and Nuclear** 1644
Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

**25 Physics, Plasma** 1645
Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

**26 Physics, Solid-State** 1647
Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

**27 Propellants** 1662
Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

**28 Propulsion Systems** 1663
Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

**29 Space Radiation** 1665
Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics, and 24 Physics, Atomic, Molecular, and Nuclear.

**30 Space Sciences** 1669
Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbits and trajectories. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

**31 Space Vehicles** 1671
Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

**32 Structural Mechanics** 1674
Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

**33 Thermodynamics and Combustion** 1681
Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

**34 General** 1683
Includes information of a broad nature related to industrial applications and technology, and to basic research; defense aspects; information retrieval; management; law and related legal matters; and legislative hearings and documents.

page

SUBJECT INDEX ..... I-1
PERSONAL AUTHOR INDEX ..... I-49
CORPORATE SOURCE INDEX ..... I-57
CONTRACT NUMBER INDEX ..... I-69
REPORT/ACCESSION NUMBER INDEX ..... I-73

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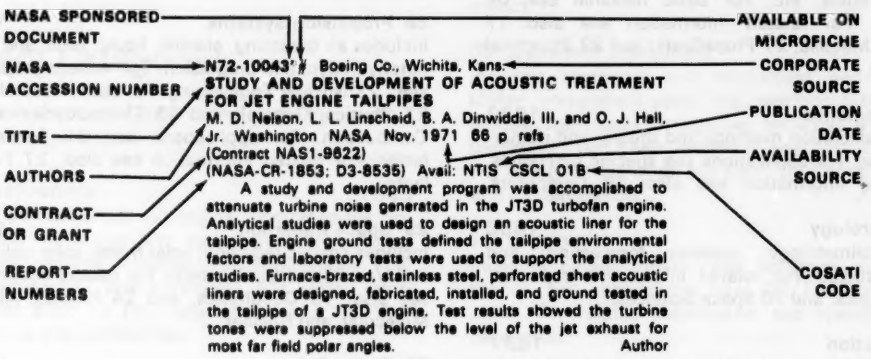
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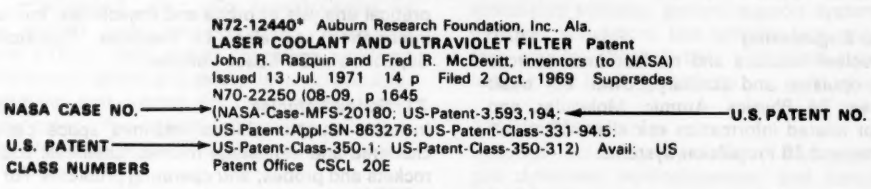
N72-10043*# Boeing Co., Wichita, Kans.
STUDY AND DEVELOPMENT OF ACOUSTIC TREATMENT FOR JET ENGINE TAILPIPES
M. D. Nelson, L. L. Linscheid, B. A. Dinwiddie, III, and O. J. Hall, Jr. Washington NASA Nov. 1971 66 p refs
(Contract NAS1-9822)
(NASA-CR-1853; D3-8535) Avail: NTIS CSCL 01B
A study and development program was accomplished to attenuate turbine noise generated in the JT3D turbofan engine. Analytical studies were used to design an acoustic liner for the tailpipe. Engine ground tests defined the tailpipe environmental factors and laboratory tests were used to support the analytical studies. Furnace-brazed, stainless steel, perforated sheet acoustic liners were designed, fabricated, installed, and ground tested in the tailpipe of a JT3D engine. Test results showed the turbine tones were suppressed below the level of the jet exhaust for most far field polar angles. Author

## PATENT CITATION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LASER COOLANT AND ULTRAVIOLET FILTER Patent
John R. Rasquin and Fred R. McDevitt, inventors (to NASA)
Issued 13 Jul. 1971 14 p Filed 2 Oct. 1969 Supersedes N70-22250 (08-09, p 1645
(NASA-Case-MFS-20180; US-Patent-3,593,194; US-Patent-Appl-SN-863276; US-Patent-Class-331-94.5; US-Patent-Class-350-1; US-Patent-Class-350-312) Avail: US Patent Office CSCL 20E

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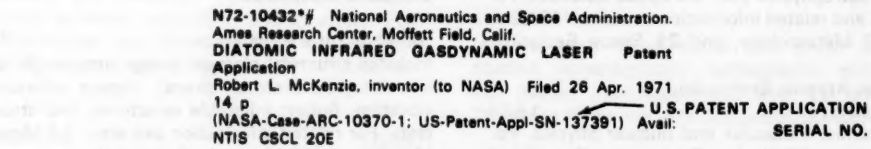
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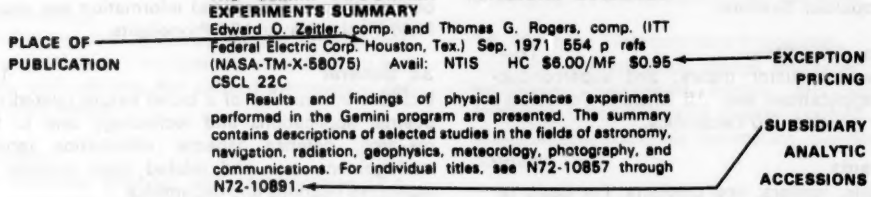
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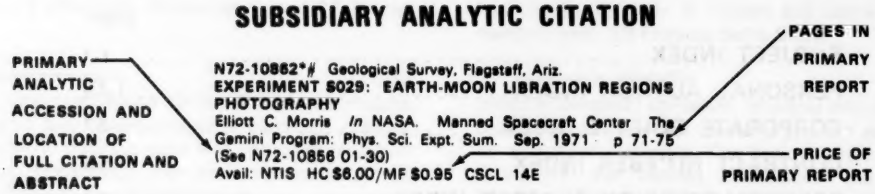
SUBSIDIARY ANALYTIC ACCESSIONS
N72-10856*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THE GEMINI PROGRAM: PHYSICAL SCIENCES EXPERIMENTS SUMMARY
Edward O. Zeitler, comp. and Thomas G. Rogers, comp. (ITT Federal Electric Corp. Houston, Tex.) Sep. 1971 554 p refs
(NASA-TM-X-58075) Avail: NTIS HC $6.00/MF $0.95 CSCL 22C
Results and findings of physical sciences experiments performed in the Gemini program are presented. The summary contains descriptions of selected studies in the fields of astronomy, navigation, radiation, geophysics, meteorology, photography, and communications. For individual titles, see N72-10857 through N72-10891.

## SUBSIDIARY ANALYTIC CITATION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N72-10862*# Geological Survey, Flagstaff, Ariz.
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Elliott C. Morris *In* NASA. Manned Spacecraft Center The Gemini Program: Phys. Sci. Expt. Sum. Sep. 1971 p 71-75
(See N72-10856 01-30)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14E

VOLUME 10 NUMBER 12 / JUNE 23, 1972

# Scientific and Technical Aerospace Reports

*A Semimonthly Publication of the National Aeronautics and Space Administration*

## 01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

**N72-20969*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**FORTRAN PROGRAM FOR GENERATING A TWO-DIMENSIONAL ORTHOGONAL MESH BETWEEN TWO ARBITRARY BOUNDARIES**
William D. McNally Washington Apr. 1972 45 p refs
(NASA-TN-D-6766; E-6644) Avail: NTIS CSCL 09B

A FORTRAN 4 program is presented which computes and plots coordinates for a two-dimensional orthogonal mesh in the region between the walls of a flow channel. The program is designed for a channel containing a body about which flow passes and which spans the channel from one wall to the other. However, the condition that the channel contain an immersed body can be easily removed from the program. Input to the program consists of spline points of the channel walls and the body geometry. Output includes printed and plotted coordinates of the generated orthogonal mesh and angles of the mesh with the horizontal plane. Author

**N72-20970*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**EXPLORATORY INVESTIGATION OF FACTORS AFFECTING THE WING TIP VORTEX**
James Scheiman, James L. Megrail, and James P. Shivers Washington Apr. 1972 52 p refs Film supplement L-1113 available on request
(NASA-TM-X-2516; L-8104) Avail: NTIS CSCL 01B

An investigation was conducted in the Langley full-scale tunnel to study some factors affecting the tip vortex of a wing. It was found that there was a pronounced effect of Reynolds number on the tip-vortex core size. An attempt was made to determine what aerodynamic parameters, such as lift, drag, or induced drag, influence the size of the vortex core, but no particular function of the parameters was found to be superior to all others. Various spoilers placed on the upper and lower surfaces of the wing to increase the boundary-layer thickness resulted in a reduction in the vorticity as determined from the tuft grid. Various solid objects placed in the vortex core downstream of the wing tip seemed to decrease the vorticity within the vortex core. Author

**N72-20971*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**SUPERSONIC AERODYNAMIC CHARACTERISTICS OF A LOW-ASPECT-RATIO MISSILE MODEL WITH WING AND TAIL CONTROLS AND WITH TAILS IN LINE AND INTERDIGITATED**
Ernald B. Graves Washington Apr. 1972 274 p
(NASA-TM-X-2531; L-8092) Avail: NTIS CSCL 01A

A study has been made to determine the aerodynamic characteristics of a low-aspect ratio cruciform missile model with all-movable wings and tails. The configuration was tested at Mach numbers from 1.50 to 4.63 with the wings in the vertical and horizontal planes and with the wings in a 45 deg roll plane with tails in line and interdigitated. Author

**N72-20972#** National Aerospace Lab., Amsterdam (Netherlands).
**LIFTING AEROFOILS WITH SUPERCRITICAL SHOCK-FREE FLOW**
J. W. Boerstoel and R. Uijlenhoet Oct. 1971 9 p refs Submitted for publication
(NLR-MP-70015-U) Avail: NTIS

Several Nieuwland lifting quasi-elliptical airfoils having supercritical shock-free flow were computed. These profiles appear to have only nose camber. The pressure distribution is of the peak type, and the major part of the loading is applied to the front half of the profiles. Tests on one of the profiles in the NLR Pilot Windtunnel show, that the flow is practically shock-free in the design condition. Due to viscous effects at the trailing edge the lift coefficient was reduced to about 80% of its theoretical value. Creep drag was not observed at Mach numbers and incidences below the design values. By deflecting a trailing edge flap, the lift loss could be reduced to about 10% without worsening the drag characteristics. Author

**N72-20973#** Army Foreign Science and Technology Center, Charlottesville, Va.
**AERODYNAMIC CALCULATION FOR HELICOPTER LIFTING ROTORS IN STEEP DESCENT (VORTEX RING METHOD)**
V. I. Shaidakov Oct. 1971 15 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekhn. (Kazan), v. 10, no. 2, 1967 p 35-40
(FSTC Proj. T7023012301)
(AD-735439; FSTC-HT-23-707-71) Avail: NTIS CSCL 01/3

The report describes calculations of the aerodynamic characteristics of a helicopter rotor at any angle of attack in a flow with comparatively high velocity. The study is concerned with the sloping descent of a helicopter and should be regarded as a first attempt to establish a theory of the aerodynamics of steep descent for helicopters. It is based upon the vortex ring method of aerodynamic calculation for lifting systems in steep descent. Author (GRA)

**N72-20974#** Air Force Armament Lab., Eglin AFB, Fla. Armament Configuration Div.
**MUTUAL AERODYNAMIC INTERFERENCE EFFECTS FOR**

**MULTIPLE BODIES BY THE CROSS-FLOW CORRECTIONS METHOD Final Report, 15 Jun. - 15 Sep. 1970**
Fred W. Martin Jun. 1971 58 p refs
(AF Proj. 2567)
(AD-735655; AFATL-TR-71-69) Avail: NTIS CSCL 01/3

The complexity of the flow field beneath an aircraft with external stores is examined analytically. Equations are produced for computing store separation trajectories, based on mutual interference flow fields between the aircraft and the store. The circle theorem and the small disturbances theory are used in establishing the perturbations responsible for the flow field interference. Author (GRA)

N72-20975# Virginia Polytechnic Inst., Blacksburg. Coll. of Engineering.
**NONEQUILIBRIUM BOUNDARY LAYER FLOW ON HIGHLY-SWEPT HYPERSONIC WINGS**
G. R. Inger Nov. 1971 22 p refs Presented at the 22nd Astronautical Congr., Brussels, 20-25 Sep. 1971
(PB-204710; VPI-E-71-23) Avail: NTIS CSCL 01A

As a first step toward dealing with nonequilibrium effects in general three-dimensional flows, these effects are analyzed for the simple, important case of laminar flow at the leading edge of a swept hypersonic infinite span wing with a highly-cooled surface, including finite surface catalycity effects. Two different types of approximate closed form solutions are developed that provide a clear physical picture and rapid estimates of the major nonequilibrium boundary layer properties in terms of the basic gas dynamic parameters. Author (GRA)

# 02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N72-20976# Advisory Group for Aerospace Research and Development, Paris (France).
**FLIGHT TEST TECHNIQUES Agard Conference Proceedings**
Feb. 1971 239 p refs Papers presented at the 38th Meeting of the Flight Mechanics Panel of AGARD, Toulouse, 10-13 May 1971
(AGARD-CP-85) Avail: NTIS

The proceedings of a conference on aircraft flight test techniques are presented. Subjects discussed are: (1) stability and control tests with emphasis on supersonic and V/STOL aircraft, (2) performance measurements of extremely fast aircraft, (3) gliding reentry vehicle tests, (4) aircraft carrier operational suitability tests, and (5) evaluation of air breathing propulsion systems. Data reduction for determining the aerodynamic characteristics of aircraft and comparison with wind tunnel test results are emphasized. The views of personnel from test pilot schools regarding flight test procedures are included. For individual titles, see N72-20977 through N72-20996.

N72-20977# Boeing Co., Seattle, Wash. Flight Test Engineering - Operations.
**STABILITY AND CONTROL 747 FLIGHT TESTING**
D. D. Archer *In* AGARD Flight Test Tech. Feb. 1972 12 p (See N72-20976 12-02)
Avail: NTIS

The basic development and FAA certification flight test program of the 747 aircraft was conducted using five test airplanes in an intensive program involving 1443 flight hours and a total of 10-2/3 months of flight testing. Each airplane was instrumented to perform assigned tasks, and sufficient duplication in instrumentation was provided to allow flexibility in re-assigning tests for schedule changes due to development contingencies. Stability and control tests were conducted on four of the airplanes and consisted of 90 hours of development tests and 72 hours of FAA tests for a total of 162 hours. In addition, airplane handling characteristics have since been evaluated by certification authorities of Great Britain, France, and Germany. All pilots who have participated in the test programs have judged the flight handling characteristics as excellent. Author

N72-20978# Aerospatiale Usines de Toulouse (France).
**METHODS OF UTILIZING THE RESULTS OF FLIGHT TESTS FOR THE STUDY OF FLIGHT PERFORMANCE OF THE CONCORDE SUPERSONIC TRANSPORT [METHODES D'UTILISATION DES RESULTATS D'ESSAIS EN VOL POUR L'ETUDE DES QUALITES DE VOL DE L'AVION DE TRANSPORT SUPERSONIQUE CONCORDE]**
R. Deque and C. Pelagatti *In* AGARD Flight Test Tech. Feb. 1972 16 p In FRENCH (See N72-20976 12-02)
Avail: NTIS

The classic parameters of flight mechanics recorded onboard the Concorde are compared to those obtained by simulation. Data cover aerodynamic limitations, stability and control systems, and instrument performance. Also given are the flight parameters used to study the flight qualities and the mathematical models used to determine them. Results show small differences in form and precision accuracy of the two methods. Transl. by E.H.W.

N72-20979# Air Force Flight Test Center, Edwards AFB, Calif.
**AN APPROACH TO STALL/SPIN FLIGHT TEST OF MANEUVERING-TYPE AIRCRAFT**
Collet E. McElroy *In* AGARD Flight Test Tech. Feb. 1972 6 p refs (See N72-20976 12-02)
Avail: NTIS

Procedures for modifying the conventional stall and spin type of flight tests on high performance aircraft are presented. Specific aspects of the stall and spin tests are: (1) evaluation of natural/artificial stall warning that indicates the approach of maximum usable lift, (2) determination of the angle of attack for maximum usable lift, (3) evaluation of natural/artificial loss-of-control warning and tests of departure prevention device, and (4) determination of all possible out-of-control events and effective recovery techniques. Examples of the control application and stall/departure entry conditions for four conditions are detailed. Author

N72-20980# Hawker Siddeley Aviation, Ltd., Kingston upon Thames (England).
**THE HARRIER - SOME ASPECTS OF V/STOL STABILITY AND CONTROL FLIGHT TESTING**
R. J. Balmer *In* AGARD Flight Test Tech. Feb. 1972 11 p refs (See N72-20976 12-02)
Avail: NTIS

The dynamic stability of V/STOL aircraft in general and a description of the aerodynamic characteristics of the P-1127 aircraft are presented. The techniques used for the initial hovering and transition flights of the P-1127 are described. The development of the Harrier aircraft from the P-1127 configuration is discussed. Examples are given of some of the special stability and control techniques used during development of the Harrier aircraft. Special cockpit instruments and onboard flight data recorders are described. Author

N72-20981# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
**FLIGHT TESTS OF THE PERFORMANCE OF THE DO-31 AIRCRAFT [ESSAIS SUR LES QUALITES DE VOL DU DO 31]**
R. Draganow *In* AGARD Flight Test Tech. Feb. 1972 9 p In FRENCH (See N72-20976 12-02)
Avail: NTIS

A description is given of the program used to analyze the

flight characteristics of the VOTOL aircraft DO-31. Studies were made of the principles of control and stability and the traits of large and small flying seats. Tests for a prototype DO-31E, are included. Transl. by E.H.W.

**N72-20982#** Aerospatiale Usines de Toulouse (France).
**MEASURE OF PERFORMANCE. METHODS OF ANALYSIS AND APPLICATION TO THE CONCORDE [MESURE DES PERFORMANCES. METHODES D'ESSAIS EN VOL APPLIQUEES A CONCORDE]**
J. Tourraille and R. Langlade *In* AGARD Flight Test Tech. Feb. 1972 19 p In FRENCH (See N72-20976 12-02)
Avail: NTIS

The principle test methods utilized in aerospace to measure the performance of the Concorde aircraft are presented. Data cover operational performance, takeoff and landing trajectories, and the precision of instruments necessary to calculate performance. Transl. by E.H.W.

**N72-20983*#** National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
**TECHNIQUES FOR THE EVALUATION OF AIR-BREATHING PROPULSION SYSTEMS IN FULL-SCALE FLIGHT** c28
Donald R. Bellman, Frank W. Burcham, Jr., and Norman V. Taillon *In* AGARD Flight Test Tech. Feb. 1972 15 p refs (See N72-20976 12-02)
(NASA-TM-X-68305) Avail: NTIS CSCL 21A

Techniques for evaluating air breathing propulsion systems in full scale flight are discussed. Examples of flight test techniques being used to measure the performance of turbojet propulsion systems are presented. Included are the determination of jet engine thrust, the study of inlet pressure phenomena, the measurement of exhaust nozzle characteristics, and the use of tufts at supersonic speeds. A flow diagram of a gas generator method of thrust calculation is illustrated. Author

**N72-20984#** Centre d'Essais en Vol, Bretigny-sur-Orge (France).
**SOME ASPECTS OF FLIGHT MEASUREMENTS AND CALIBRATIONS**
J. F. Renaudie *In* AGARD Flight Test Tech. Feb. 1972 12 p (See N72-20976 12-02)
Avail: NTIS

The calibration, application, and limitations of instruments used for flight tests are discussed. The various aspects of flight testing which are presented are: (1) airspeed measurement, effects of atmospheric pressure at supersonic speed, (3) errors introduced by pitot-static boom location, (4) atmospheric calibration curves for high and low altitude, and (5) correlation of flight test and wind tunnel test data. The main source of errors in various aspects of flight testing are examined and corrective actions are recommended. Author

**N72-20985#** Air Force Flight Test Center, Edwards AFB, Calif. Performance and Flying Qualities Branch.
**CRUISE PERFORMANCE TESTING OF ADVANCED AIRCRAFT**
Richard R. Hildebrand *In* AGARD Flight Test Tech. Feb. 1972 12 p ref (See N72-20976 12-02)
Avail: NTIS

The expanded performance capabilities of modern, high performance aircraft have necessitated the development of flight test techniques and methods of data analysis and presentation which differ from those traditionally employed. The variable-geometry wing of the F-111 presented the flight test engineer with the problem of defining and presenting cruise performance for a potentially infinite number of differently configured airplanes. The introduction of aircraft specifically designed to cruise at high supersonic Mach numbers presented still other problems. Some of the problems encountered and solutions developed during flight testing of such aircraft as the F-111, B-58, and SR-71 are presented. Author

**N72-20986*#** National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
**LIFTING BODY FLIGHT-TEST TECHNIQUES**
Garrison P. Layton, Jr. and Milton O. Thompson *In* AGARD Flight Test Tech. Feb. 1972 9 p refs (See N72-20976 12-02)
(NASA-TM-X-68306) Avail: NTIS CSCL 01B

Specific techniques and procedures for conducting flight tests of lifting body type aircraft are presented. The characteristics of the aircraft in transonic and supersonic flight regions were investigated. The data collection and analysis techniques with which the flight results were analyzed are outlined. Included are analog and digital matching techniques for derivative extractions and a method for extracting lift and drag data. Problems encountered in the flight test program and methods for solving these problems are discussed. Author

**N72-20987#** Aerospace Engineering Test Establishment, Ottawa (Ontario).
**ACCEPTANCE FLIGHT TESTING OF MILITARY AIRCRAFT**
E. J. Sinnett and L. V. P. Galvin (USABPA, Ft. Worth, Tex.) *In* AGARD Flight Test Tech. Feb. 1972 4 p (See N72-20976 12-02)
Avail: NTIS

The acceptance flight test procedures developed and used by the Canadian Armed Forces are presented. The techniques are applied to all aircraft on initial delivery and following repair and overhaul to ensure proper operation of all aircraft systems by logical functional checks and quality control procedures. Crew requirements for performing the flight tests are outlined. Author

**N72-20988#** Naval Air Test Center, Patuxent River, Md. Carrier Suitability Branch.
**CARRIER SUITABILITY TESTS**
Roger M. Decker *In* AGARD Flight Test Tech. Feb. 1972 16 p (See N72-20976 12-02)
Avail: NTIS

A resume of tests performed to determine the suitability of an airplane for launching and recovery operations in aircraft carriers is presented. Carrier suitability testing involves for the most part the blending of the pilot/airframe combination with special equipment in this unique environment. Flight test methods utilized to define the performance and handling qualities of an airplane are not unique and are given only cursory treatment. Criteria which should be considered in the design of carrier-based aircraft so as to most advantageously match an airplane to the carrier environment are presented. Author

**N72-20989#** Air Force Flight Test Center, Edwards AFB, Calif.
**FLIGHT TESTING FOR TURNING PERFORMANCE**
Roger C. Crane *In* AGARD Flight Test Tech. Feb. 1972 10 p refs (See N72-20976 12-02)
Avail: NTIS

The types of performance test maneuvers used for evaluating the turning capability of military aircraft are presented. The application of the turning performance techniques to F-104, F-4, F-4E, and F-111D aircraft is discussed. The techniques for determining the turning limitations imposed by airframe lift and engine thrust production are described. Author

**N72-20990#** Royal Aircraft Establishment, Bedford (England).
**STABILITY AND CONTROL TESTS ON A SLENDER WING RESEARCH AIRCRAFT**
P. L. Bisgood *In* AGARD Flight Test Tech. Feb. 1972 13 p refs (See N72-20976 12-02)
Avail: NTIS

A variety of flight test techniques has been used to measure the stability and control characteristics of a slender-wing research, aircraft as part of a program aimed at comparing wind tunnel and flight measurements. Derivatives obtained by alternative methods in flight usually showed satisfactory agreement. Conventional methods of derivative extraction proved adequate

in areas where minor non-linearities occurred in the aerodynamic coefficients. Where more pronounced non-linearities exist, as in the longitudinal case, the results indicate that conventional techniques may not be entirely adequate. Author

N72-20991# Fiat S.p.A., Turin (Italy). Flight Mechanics Engineering.
**AN INTEGRAL METHOD FOR EXTRACTION OF AERODYNAMIC COEFFICIENTS FROM FLIGHT-TEST DATA** c19
G. P. Foroni *In* AGARD Flight Test Tech. Feb. 1972 6 p refs (See N72-20976 12-02)
Avail: NTIS

The application of the equations of motion methods, which in the praxis are the most advantageous, shows some difficulties and failures in the effectiveness and generality of employment. In order to overcome these deficiencies, after a short review of the principal methods, an integral procedure has been developed, which is a synthesis of the Fourier Transform and Shinbrot's methods; and it has also all the advantages of them. The method accuracy has then been improved by applying an optimization process of the mathematical model, based on the O.H. Gerlach correlation-coefficients. Author

N72-20992# Technische Hogeschool, Delft (Netherlands).
**THE DETERMINATION OF STABILITY DERIVATIVES AND PERFORMANCE CHARACTERISTICS FROM DYNAMIC MANOEUVRES**
O. H. Gerlach *In* AGARD Flight Test Tech. Feb. 1972 23 p refs (See N72-20976 12-02)
Avail: NTIS

Three frequency ranges of interest to the flight dynamicist are distinguished: (1) the low-frequency or phugoid and spiral mode frequency range, (2) the intermediate or short-period and Dutch roll frequency range, and (3) the high-frequency or elastic modes frequency range. Until today most flight tests for the determination of stability derivatives have been directed towards the intermediate frequency range. Since for various reasons the frequency ranges show an increasing trend to overlap for several classes of modern aircraft, flight test techniques suitable for more than one frequency range may well receive more attention. Flight tests to determine derivatives in the combined low and intermediate frequencies are described. The importance of accurate measurements and of an adequate frequency content of the input signal in the flight tests is stressed. The rationale behind the choice of the shape of the input signal used in the flight tests is given. The application of the derivatives, not only for stability and control purposes, but also for the determination of performance characteristics, is discussed. Author

N72-20993# Centre d'Essais en Vol, Istres (France).
**SCHOOL OF NAVIGATION PERSONNEL FOR TESTS AND RECEPTION [L'ECOLE DU PERSONNEL NAVIGANT D'ESSAIS ET DE RECEPTION]** c11
Francois Cousson *In* AGARD Flight Test Tech. Feb. 1972 11 p In FRENCH (See N72-20976 12-02)
Avail: NTIS

The formation of a French school, necessary to train navigation specialists in flying techniques, is discussed. The school is open to foreign personnel on an equal basis. The particular characteristics necessary for the administration of flying instruction on the ground and in the air are included.
Transl. by E.H.W.

N72-20994# Air Force Flight Test Center, Edwards AFB, Calif.
**US AIR FORCE AEROSPACE RESEARCH PILOT SCHOOL** c11
Spence M. Armstrong *In* AGARD Flight Test Tech. Feb. 1972 8 p (See N72-20976 12-02)
Avail: NTIS

The organization and operation of the U.S. Air Force Test Pilot School at Edwards AFB, California is discussed. Subjects presented are: (1) the mission of the school, (2) the staff, (3) student qualification, (4) the curriculum, (5) the flying program, and (6) methods of instruction. Additional discussion is presented on the assignment of students after graduation and future plans for the school. Author

N72-20995# Royal Air Force, Farnborough (England).
**TRAINING PILOTS TO ASSESS FLIGHT SYSTEMS AT THE EMPIRE TEST PILOTS' SCHOOL** c11
A. A. Clark *In* AGARD Flight Test Tech. Feb. 1972 6 p (See N72-20976 12-02)
Avail: NTIS

The syllabus and training curriculum for the Empire Test Pilot School in England is presented. One aspect of the training, which is identified as assessment of flight systems, is emphasized. Features of the system are: (1) a ground training program in systems and control engineering, (2) an autopilot investigation exercise, (3) two simulator exercises, (4) an inflight autopilot assessment, and (5) a flight path control system assessment.
Author

N72-20996# Naval Air Test Center, Patuxent River, Md.
**US NAVAL TEST PILOT TRAINING** c11
Robert V. Sallada *In* AGARD Flight Test Tech. Feb. 1972 15 p (See N72-20976 12-02)
Avail: NTIS

The philosophy of instruction, as it pertains to the education of U.S. Naval engineering test pilots and engineers is discussed. Selection processes, the composition of classes, and detailed scope of both academic and flight (fixed and rotary wing) syllabi are included. The fleet of aircraft is described, along with the use of each particular airplane-type in the curriculum. Also provided is a recent staff reorganization and major plans for the future which will substantially improve the student education and Navy test pilot utilization. Author

N72-20997# Transportation Systems Center, Cambridge, Mass.
**THE CALCULATION OF AIRCRAFT COLLISION PROBABILITIES**
Juan F. Bellantoni Oct. 1971 43 p refs
(DOT-TSC-FAA-71-27) Avail: NTIS

A method for calculating the aircraft collision probability due to reduced separations of commercial aircraft is discussed. The statistical-probabilistic method of collision probability calculation, which has been limited to parallel, straight line flight paths, is extended to arbitrary flight paths and vehicle shapes. The general formula is specialized to cases of large relative velocity, non-zero relative velocity, zero relative velocity, and spherical collision surface. The formulas are applied to indpendent curved landing approaches to parallel runways. Author

N72-20998# Transportation Systems Center, Cambridge, Mass.
**VISIBILITY CONCEPTS AND MEASUREMENT TECHNIQUES FOR AVIATION PURPOSES Final Report**
G. T. Schappert Jul. 1971 109 p refs
(DOT-TSC-FAA-71-25) Avail: NTIS

Present techniques for measuring atmospheric transmittance and its conversion to runway visual range are reviewed. The response of the pilot to visual cues used in determining the visibility is discussed as a function of his cockpit environment. The lights utilized by the FAA as targets for visibility determinations are discussed and used in the computations. New techniques for visibility measurements and new concepts and definitions are discussed and analyzed. The emphasis is on techniques for measuring slant visual range by means of optical remote sensing devices. Various problems relating to atmospheric modeling, signal processing, and eye safety aspects are discussed. Author

N72-20999# Transportation Systems Center, Cambridge, Mass.
**AIRCRAFT WAKE VORTEX SENSING SYSTEMS**
D. Burnham, M. Gorstein, J. Hallock, R. Kodis, I. McWilliams, and T. Sullivan Jun. 1971 70 p refs

(DOT-TSC-FAA-72-13) Avail: NTIS

Active and passive techniques for detecting and measuring air movements such as those associated with wingtip vortices within an area or throughout a volume of terminal airspace are presented. Usable techniques, with an appraisal of expected performance and inherent limitations, are described. Results of preliminary feasibility tests employing available technology are presented. The major effort is directed toward the location of wake vortex hazards and the generation of monitoring requirements for safe operation in the airport terminal environment. Author

**N72-21000#** Transportation Systems Center, Cambridge, Mass.
**PROPOSED CONTROL TOWER AND COCKPIT VISIBILITY READOUTS BASED ON AN AIRPORT-AIRCRAFT INFORMATION FLOW SYSTEM**
Hector C. Ingrao and J. R. Lifsitz Jul. 1971 47 p refs
(DOT-TSC-FAA-71-18) Avail: NTIS

The problem of displaying visibility information to both controller and pilot is discussed in the context of visibility information flow in the airport-aircraft system. The optimum amount of visibility information, as well as its rate of flow and display, depends both on the needs of the pilot during landing and on the air traffic control philosophy (tactical or strategic) chosen. A rationale is provided to assist in the selection of flow rates and readouts. The relationship of visibility information to the magnitude of terminal information handled by the pilot is discussed. Several display formats are proposed, including one for the traffic controller and three different options for the pilot. Author

**N72-21001*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**PEAK AXIAL-VELOCITY DECAY WITH MULTI-ELEMENT RECTANGULAR AND TRIANGULAR NOZZLES**
D. E. Groesbeck, U. H. vonGlahn, and R. G. Huff Mar. 1972 28 p refs
(NASA-TM-X-68047) Avail: NTIS CSCL 01B

The aircraft noise created by the impingement of engine exhaust jet of STOL aircraft with exterally blown flaps is discussed. It was determined that the jet-flap interaction noise can be lowered by reducing the impinging velocity of the jet. The reduction must occur at a specific distance from the flap to be effective. The peak axial-velocity decay obtained with rectangular and triangular single element mixer nozzles is presented. Equations are developed for estimating the peak axial velocity decay curves for a wide range of nozzle configurations. Author

**N72-21002#** National Transportation Safety Board, Washington, D.C.
**AIRCRAFT ACCIDENT REPORT: MONMOUTH AIRLINES, INCORPORATED, SCHEDULED AIR TAXI, BEECH 99, N986MA, ALLENTOWN-BETHLEHEM-EASTON AIRPORT, ALLENTOWN, PENNSYLVANIA, 24 OCTOBER 1971**
29 Dec. 1971 18 p
(NTSB-AAR-72-3) Avail: NTIS

The crash of a Beechcraft Model 99 aircraft engaged in air taxi service at Allentown, Pennsylvania on 24 October, 1971 is reported. The accident occurred during an instrument approach to the Allentown-Bethlehem-Easton airport. The accident was believed to be due to the pilot's nonadherence to approved approach procedures for executing a nonprecision instrument approach in instrument flight conditions. Author

**N72-21003#** National Transportation Safety Board, Washington, D.C.
**AIRCRAFT ACCIDENT REPORT: ALOHA AIRLINES, INCORPORATED, VICKERS VISCOUNT MODEL 745D, N7415, HONOLULU INTERNATIONAL AIRPORT, HONOLULU, HAWAII, 8 AUGUST 1971**
29 Dec. 1971 17 p
(NTSB-AAR-72-2) Avail: NTIS

Vickers Viscount 745D, N7415 was operating between Hilo and Honolulu, Hawaii. After landing at Honolulu and during taxi to the terminal, smoke was detected coming from below the passenger cabin floor. The aircraft was stopped on the taxiway, the engines were shut down and all passengers and crewmembers evacuated without incident. The fire was extinguished by airport emergency equipment. The probable cause of this accident was an undetected electrical short within the left nickel-cadmium aircraft battery, which resulted in the absorption of an increasing amount of heat energy over an unknown period of time, and progressed to a state of thermal runaway. Author

**N72-21004*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**LIGHTWEIGHT, VARIABLE SOLIDITY KNITTED PARACHUTE FABRIC Patent Application**
Frederick R. Matthews, Jr. and Erskine C. White, inventors (to NASA) Filed 23 Dec. 1971 14 p
(NASA-Case-LAR-10776-1; US-Patent-Appl-SN-221332) Avail: NTIS CSCL 11E

A parachute fabric for aerodynamic decelerator applications is discussed. The fabric will permit deployment of the decelerator at high alitudes and low density conditions. The fabric consists of lightweight, highly open, circular knitted parachute fabric with ribbon-like yarns to assist in air deflection. NASA

**N72-21005*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**WIND-TUNNEL INVESTIGATION OF THE AERODYNAMIC CHARACTERISTICS OF THE M2-F2 LIFTING-BODY ENTRY CONFIGURATION AT TRANSONIC AND SUPERSONIC MACH NUMBERS**
Earl R. Keener and Jack J. Brownson Washington Apr. 1972 135 p refs
(NASA-TM-X-2511; A-4131) Avail: NTIS CSCL 01B

Results are presented for wind tunnel tests of a one to twelve scale model of the M2-F2 lifting body entry configuration at transonic and supersonic speeds. The Mach number was varied from 0.6 to 2.0. Reynolds numbers ranged from 4 to 13 million. Angles of attack and sideslip varied from minus 8 degrees to plus 20 degrees and minus 4 degrees to plus 6 degrees respectively. A brief history of the development of the configuration is included. Author

**N72-21006*#** Scientific Translation Service, Santa Barbara, Calif.
**STABILITY AND CONTROL OF HYPERSONIC AIRCRAFT**
R. Ceresuela Washington NASA Apr. 1972 33 p refs Transl. into ENGLISH from "Stabilite et Controle d'Avions Hypersoniques", Office National d'Etudes et de Recherches Aerospatiales, report TP-1014
(Contract NASw-2035)
(NASA-TT-F-14235) Avail: NTIS CSCL 01B

Problems in the aerodynamics of sustained hypersonic flight including maximal lift/drag ratios and longitudinal and lateral stabilities related to large volume engines are discussed. The compatibility of internal and external flows is examined for highly deformed intakes and exhausts. F.O.S.

**N72-21007#** Air Force Flight Test Center, Edwards AFB, Calif.
**EXPERIMENTAL DETERMINATION OF THE MOMENTS OF INERTIA, PRODUCT OF INERTIA, AND THE INCLINATION OF THE PRINCIPAL AXIS OF CONVENTIONAL AIRCRAFT BY THE SPRING OSCILLATION METHOD**
Edward N. Bradfield Jun. 1971 63 p refs
(FTC-TIM-71-1001) Avail: NTIS

The equipment and techniques for conducting moment of inertia tests on A-37 and P-1127 aircraft are discussed. The manner in which the tests can be conducted simply, safely, and with Air Force Flight Test Center facilities and personnel is described. Data reduction and analysis methods are explained. Author

N72-21008*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
**AN INDICATING SYSTEM FOR AIRCRAFT Patent Application**
Anne W. Story, inventor (to NASA) Filed 16 Mar. 1971 18 p (NASA-Case-ERC-10226-2; US-Patent-Appl-SN-124909) Avail: NTIS CSCL 01B

A pilot warning indicator system is disclosed which includes a flashing beacon, a detector, and an indicating panel on each aircraft. The detector responds to radiant energy from another aircraft's beacon by energizing particular signal lamps positioned in the periphery of the pilot's normal field of view. Since the positions of the energized lamps are related to the direction from which radiant energy is received by the detector, the pilot is apprised of the relative position of an intruder aircraft without any shift in visual fixation. NASA

N72-21009*# National Academy of Sciences-National Research Council, Washington, D.C.
**SUPPRESSION OF FLUTTER Patent Application**
Eliahu Nissim, inventor (to NASA) Filed 25 Mar. 1971 24 p Sponsored by NASA
(NASA-Case-LAR-10682-1; US-Patent-Appl-SN-127915) Avail: NTIS CSCL 01B

An active aerodynamic control system is described for controlling flutter over a large range of oscillatory frequencies unaffected by mass, stiffness, elastic axis, or center of gravity location of the system, mode of vibration, or subsonic Mach number. It consists of one or more pairs of leading edge and trailing edge, hinged or deformable control surfaces, each pair operated in concert by a stability augmentation system. Torsion and bending motions or deflections of the fluttering member are sensed and converted by the stability augmentation system into leading and trailing edge control surface deflections which produce lift forces and pitching moments to suppress flutter. NASA

N72-21010*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**DUAL FUSELAGE AIRCRAFT HAVING YAWABLE WING AND HORIZONTAL STABILIZER Patent Application**
Robert T. Jones, inventor (to NASA) Filed 9 Dec. 1971 34 p (NASA-Case-ARC-10470-1; US-Patent-Appl-SN-206279) Avail: NTIS CSCL 01B

An aircraft has been designed that consists of a pair of fuselages arranged in parallel and coupled together by a main wing and a horizontal stabilizer which are pivotally attached to the fuselages. The pivotal attachment allows the airfoils to be yawed relative to the fuselages for high speed flight while at the same time spreading the weight and volume distribution of the aircraft along the direction of flight. The main wing is upwardly curved at the ends to compensate for any roll tendency caused by its yawed positioning. NASA

N72-21011# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
**AERODYNAMIC NOISE REDUCTION BY CONTROLLED INTERFERENCE [VERMINDERUNG DES FLUGLAERMS DURCH GESTEUERTE INTERFERENZ]**
Oskar Bschorr Cologne DGLR 1 Jan. 1971 28 p refs In GERMAN Presented at the 4th DGLR Annual Meeting, Baden-Baden, West Ger., 11-13 Oct. 1971
(MBB-BB-55-71-O) Avail: NTIS

The possibilities and limits of controlled sound-sound interference to realize engine and aerodynamic noise reduction were investigated. In particular, noise extinction was studied for aircraft piston engines, propellers, rotors, and jet engines. Engine and rotor noise are essentially periodic and determined sound fields which can be extinguished using a forced synchronous, programmed, anti-sound generator. For jet noise, a feedback loop consisting of sound sensor and anti-sound source is necessary. ESRO

N72-21012# Stevens Inst. of Tech., Hoboken, N.J.
**TWENTY-TON WHEELED AIR CUSHION LIGHTER CONCEPTUAL DESIGN Technical Report, Dec. 1970 - Dec. 1971**
Naresh M. Maniar, Samuel Tsui, Stephen Halpern, I. Robert Ehrlich, and Irmin O. Kamm Dec. 1971 181 p refs Prepared in cooperation with Stevens Inst. of Tech., Hoboken, N. J.
(Contract DAAK02-71-C-0114)
(AD-735667; Rept-2075-1) Avail: NTIS CSCL 13/10

The objectives of this project were to perform the concept formulation of a new U.S. Army Lighter of 20-long ton capacity which could transport a MILV.^N container and palletized cargo from container ships stationed offshore to shore and inland with a minimum smooth water speed of 15 knots. The design aimed at high reliability and maximum use of commercially available components. Author (GRA)

N72-21013# AAI Corp., Cockeysville, Md.
**LOW ALTITUDE AIRDROP SYSTEM INVESTIGATION EMPLOYING INFLATION-AIDED RECOVERY PARACHUTES FOR EXTRACTION Final Technical Report**
Bruce W. Jezek and Kenneth E. Mueller Natick, Mass. Army Natick Labs. Oct. 1971 185 p refs
(Contract DAAG17-68-C-0036; DA Proj. 1M1-21401-D-195)
(AD-735375; TR-72-15-AD) Avail: NTIS CSCL 15/5

The report presents results of study of an airdrop system utilizing the recovery parachutes to extract as well as to recover the airdrop load. The goal was to achieve a low altitude capability by minimizing the altitude loss from the time that the load clears the aircraft until an acceptable impact velocity is achieved. Mathematical models were developed and programmed for computer solution which simulated the operation of an airdrop system. This analytical tool, coupled with experimental data derived from a limited flight test program, was utilized to conceptualize a configuration for an airdrop system and predict its theoretical performance. From these studies emerged an understanding of possible configurations for a low altitude airdrop system employing the recovery parachutes for extraction. Author (GRA)

N72-21014# National Aeronautical Establishment, Ottawa (Ontario).
**A FLIGHT INVESTIGATION OF LATERAL-DIRECTIONAL HANDLING QUALITIES FOR V/STOL AIRCRAFT IN LOW SPEED MANOEUVRING FLIGHT**
K-H. Doetsch, Jr., D. G. Gould, and D. M. McGregor Oct. 1971 153 p Sponsored by the AF
(AD-735420; NAE-LR-549; NRC-12285) Avail: NTIS CSCL 01/3

An investigation to determine the ranges of various lateral-directional characteristics required to provide adequate flying qualities for turning manoeuvres at low speed was undertaken using an airborne V/STOL aircraft simulator. Five parameters were varied in a systematic manner: the damping ratio, the frequency and the ratio of the roll-angle to the sideslip-angle in the Dutch roll mode, together with the damping ratio and frequency of the numerator quadratic of the roll-angle to aileron-control-input transfer function. The pilots performed a low speed, visual manoeuvring task and documented their assessment of the characteristics through extensive comments and a numerical rating. Author (GRA)

N72-21015# Naval Air Development Center, Johnsville, Pa. Aero Structures Dept.
**STATISTICAL METHODS AND THEIR APPLICATION TO ESTABLISHING FLIGHT MANEUVER LOADS DESIGN CRITERIA FOR FIGHTER AIRCRAFT Summary Report**
Thomas A. DeFiore and William C. Stewart 1 Sep. 1971 54 p refs
(AD-735472; NADC-ST-7101) Avail: NTIS CSCL 20/11

The report provides statistical methods for use in establishing positive maneuver loads design criteria for fighter aircraft. These methods are applied to counting accelerometer data and

comparisons between operational loads data and military specifications are presented. Author (GRA)

N72-21016# Naval Aerospace Medical Inst., Pensacola, Fla.
**ORIENTATION ERROR ACCIDENTS IN REGULAR ARMY UH-1 AIRCRAFT DURING FISCAL YEAR 1968: RELATIVE INCIDENCE AND COST**
Jorma I. Niven, W. Carroll Hixson, and Emil Spezia 15 Oct. 1971 36 p refs
(MF Proj. 12.524.005)
(AD-735457; NAMRL-1145; USAARL-72-5) Avail: NTIS CSCL 01/2

The report is the second in a longitudinal series of reports dealing with the magnitude of the pilot disorientation/vertigo accident problem in Regular Army UH-1 helicopter operations. Incidence and cost data presented for fiscal year 1968 include a total of 53 major and minor orientation-error accidents (17 of which were fatal), resulting in 74 fatalities, 60 nonfatal injuries, and $8,224,607 aircraft damage. Author (GRA)

N72-21017# Northern Research and Engineering Corp., Cambridge, Mass.
**ASSESSMENT OF AIRCRAFT EMISSION CONTROL TECHNOLOGY**
E. K. Bastress, R. C. Baker, C. F. Robertson, R. D. Siegel, and G. E. Smith Sep. 1971 206 p refs
(Contract EPA-68-04-0011)
(PB-204878; NREC-1168-1; APTD-0850) Avail: NTIS CSCL 13B

The results are presented of an investigation which was aimed at providing information for establishing standards on emissions from aircraft activities. The program consisted of independent investigation of the following topics: emission control by engine modification; emission control by ground operations modification; emission control by fuel modification; and emission measurement. Engine modification control methods were identified through reviews of earlier work and through discussions with engine manufacturers. A list of specific control methods was formulated on the basis of preliminary analyses in which feasibility was indicated. The preliminary list of control methods was then subjected to more detailed analysis of control effectiveness and implementation costs. Ground operations modification control methods were evaluated in a similar manner. GRA

N72-21018# AiResearch Mfg. Co., Phoenix, Ariz.
**EXHAUST EMISSIONS TEST AIRESEARCH AIRCRAFT PROPULSION AND AUXILIARY POWER GAS TURBINE ENGINES**
10 Sep. 1971 420 p refs Sponsored by Environ. Protection Agency
(PB-204920; GT-8747-R; APTD-0849) Avail: NTIS HC $6.00/MF $0.95 CSCL 13B

The test setup, procedure, and analysis are described of exhaust emissions measurement conducted on 32 commercial gas turbine engines comprised of both on-board aircraft auxiliary power and aircraft propulsion production, overhaul, and development units. The units selected are currently active in commercial airline service and thus contribute to aircraft related pollution levels. The purpose of the test was to measure exhaust emissions from auxiliary power and small aircraft propulsion gas turbine engines to establish base levels of unburned hydrocarbons, carbon monoxide, carbon dioxide and oxides of nitrogen in current existing engine designs. In addition, a survey of engine duty cycles as related to normal customer operation in the field was made to determine a typical duty cycle and the corresponding estimated level of exhaust emissions produced. Author (GRA)

N72-21019# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**SOVIET AERONAUTICAL ENGINEERING**
A. N. Tupolev and L. A. Gilberg 20 Nov. 1971 253 p refs Transl. into ENGLISH of the Publ. "Sovetskaya Aviatsionnaya Tekhnika" Moscow, Mashinostr., 1970, p 1-176
(FTD Proj. 20906391)
(AD-735204; FTD-HT-23-21-71) Avail: NTIS CSCL 01/1

The book traces the development of Soviet aviation from pre-Revolution days to 1970. It includes many photographs of the latest model Soviet aircraft. Author (GRA)

N72-21020# National Transportation Safety Board, Washington, D.C.
**AIRCRAFT ACCIDENT REPORT DELTA AIRLINES, INCORPORATED DOUGLAS DC-9-32, N3329L LOUISVILLE, KENTUCKY, 8 SEPTEMBER 1970**
17 Nov. 1971 17 p
(PB-205250; NTSB-AAR-71-15) Avail: NTIS CSCL 01B

Delta Air Lines Flight 439, touched down 156 feet short of Runway at 2114,e.d.t., while making a visual landing approach. The National Transportation Safety Board determines that the probable cause of this accident was the pilot's misjudgment of altitude due to the absence of sufficient lights in the approach area, misleading information producted by deceptive sloping terrain, and that the pilot did not position the aircraft on the ILS glide slope while he was establishing the final approach profile. Author (GRA)

N72-21021# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
**BRIEFS OF AIRCRAFT ACCIDENTS INVOLVING MISSING AIRCRAFT, US GENERAL AVIATION 1969**
Dec. 1971 102 p
(PB-205097; NTSB-AMM-71-11) Avail: NTIS CSCL 01B

The publication contains statistical, cause/factor and injury tables, accident rates and the briefs of accidents involving missing aircraft and missing aircraft, later recovered, 1969. Author (GRA)

N72-21022# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
**BRIEFS OF AIRCRAFT ACCIDENTS INVOLVING AIR TAXI, US GENERAL AVIATION, 1969**
Dec. 1971 106 p
(PB-205096; NTSB-AMM-71-10) Avail: NTIS CSCL 01B

The publication contains statistical, cause/factor and injury tables, accident rates and the briefs of accidents involving air taxi during 1969. Author (GRA)

N72-21023# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
**BRIEFS OF AIRCRAFT ACCIDENTS INVOLVING ALCOHOLIC IMPAIRMENT OF EFFICIENCY AND JUDGEMENT AS A CAUSE/FACTOR, US GENERAL AVIATION, 1969 Special Study, Calendar Year 1969**
Dec. 1971 37 p
(PB-204991; NTSB-AMM-71-12) Avail: NTIS CSCL 01B

The publication contains statistical, cause/factor and injury tables, accident rates and the Briefs of Accidents involving Alcoholic Impairment of Efficiency and Judgement as a Cause/Factor - 1969. Author (GRA)

N72-21024# National Transportation Safety Board, Washington, D.C.
**BRIEFS OF ACCIDENTS INVOLVING ROTORCRAFT. US GENERAL AVIATION 1969**
Oct. 1971 127 p
(PB-204812; NTSB-AMM-71-8) Avail: NTIS CSCL 01B

The publication contains statistical cause/factor and injury tables, accident rates and the briefs of accidents involving Rotorcraft during calendar year 1969. Author (GRA)

N72-21025# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
**BRIEFS OF ACCIDENTS INVOLVING AERIAL APPLICATION OPERATIONS. US GENERAL AVIATION 1969**
Oct. 1971 220 p
(PB-204811; NTSB-AMM-71-7) Avail: NTIS CSCL 01B

The publication contains statistical, cause/factor and injury tables, accident rates and the briefs of accidents involving aerial application operations during calendar year 1969. Author (GRA)

N72-21026# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety
**BRIEFS OF AIRCRAFT ACCIDENTS INVOLVING WEATHER AS A CAUSE/RELATED FACTOR. US GENERAL AVIATION 1969**
Dec. 1971 202 p refs
(PB-204926; NTSB-AMM-71-9) Avail: NTIS CSCL 01B

The publication contains statistical, cause/factor and injury tables, accident rates and briefs of accidents involving weather. GRA

N72-21027# Illinois Univ., Urbana. Aviation Research Lab.
**THE FREQUENCY SEPARATED DISPLAY PRINCIPLE, PHASE 3 Annual Summary Report, 1 Oct. 1970 - 30 Sep. 1971**
Stanley N. Roscoe, David C. Denney, and Steven L. Johnson
Dec. 1971 33 p refs
(Contract N00014-67-A-0305-0014; NR Proj. 196-092)
(AD-735915; ARL-71-15; ONR-71-1) Avail: NTIS CSCL 01/4

The report includes: brief reviews of the display motion relationship problem and the principle of frequency separation; a summary of the work accomplished during Phases I and II; work accomplished during Phase III; results to date; research plans for Phase IV; and personnel involved in the research. Author (GRA)

N72-21028# Boeing Co., Philadelphia, Pa. Vertol Div.
**WIND TUNNEL TEST OF THE CONVERSION PROCESS OF A FOLDING TILT ROTOR AIRCRAFT USING A SEMISPAN UNPOWERED MODEL. VOLUME 4, PART 2: BLADE STRESS ANALYSIS, BENCH TESTS, AND WIND TUNNEL MODEL DETAILS Final Report**
John Magee and Robert Taylor Aug. 1971 91 p
(Contract F33615-69-C-1577)
(AD-735733; D213-10000-Vol-4-PT-2;
AFFDL-TR-71-62-Vol-4-Pt-2) Avail: NTIS CSCL 01/3

The document presents the detailed results of the blade stress analysis and the bench tests, as well as a description of the wind tunnel and the model. Mathematical findings are given in developed equations and in voluminous tabular data. Additional information is provided in the form of engineering graphs and curves, schematic diagrams, and photographs of the model and test setup. This volume is actually an appendix to Part I, Analysis and Results. Author (GRA)

N72-21029# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**A COST/DECISION MODEL FOR THE DEFERRED PROCUREMENT OF AN AIR FORCE DEPOT MAINTENANCE CAPABILITY WITH A COMPUTERIZED APPLICATION TO THE F-15 INS M.S. Thesis**
Michael S. Clark and Robert E. Johnson Nov. 1971 230 p refs
(AD-735351; GSM/SM/71-2) Avail: NTIS CSCL 01/3

The report presents a decision model to aid decision-makers in evaluating the costs of establishing an Air Force depot maintenance capability at different points in time. The cost elements of depot maintenance are identified and defined in denotative terms. The model incorporates techniques for the explicit treatment of uncertainty, converting dollar requirements into expenditures, and the considerations of inflation and discounting (present value). Author (GRA)

N72-21030# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
**A FLIGHT TEST INVESTIGATION OF DIRECT SIDE FORCE CONTROL Final Technical Report**
G. Warren Hall Wright-Patterson AFB, Ohio AFFDL Sep. 1971 121 p refs
(Contract F33615-71-C-1240; AF Proj. 8219)
(AD-735294; CAL-BM-3053-F-1; AFFDL-TR-71-1906) Avail: NTIS CSCL 01/3

The concept of developing a controllable side force by deflecting the rudder and utilizing asymmetrical drag to cancel the resulting yawing moment was flight tested using the USAF/CAL variable stability T-33 airplane. Primary objectives of the investigation were to mechanize a system that allowed direct control of side force, qualitatively evaluate the usefulness of direct side force control and evaluate the type of controller that might be useful in its employment. Three methods for the pilot to control side force were provided: a thumb controller mounted on the stick, the aileron stick and the rudder pedals. The method of generating and controlling side force studied in the investigation is feasible and lends itself to the high drag configurations normally used in dive bombing. It was concluded that direct side force control significantly improved the pilot's ability to acquire and maintain a target, and therefore should be further investigated as a method of improving weapons delivery accuracy and general flight path control. Author (GRA)

N72-21031# Center for Naval Analyses, Arlington, Va.
**DYNAMIC PROGRAMMING APPROACH TO THE OPTIMIZATION OF NAVAL AIRCRAFT REWORK AND REPLACEMENT POLICIES**
Arnold Neil Schwartz, James A. Sheler, and Carl R. Cooper (Naval Air Sys. Command) 1971 21 p refs Rept. from Nav. Res. Logistics Quart., v. 18, no. 3, Sep. 1971 p 395-414 Revised
(AD-736094) Avail: NTIS CSCL 15/5

The paper describes a method for determining optimal repair and replacement policies for aircraft, with specific reference to the F-4. The objective of the analysis is to choose the set of policies from all possible alternatives over a finite planning horizon which minimizes the cost of operations. A dynamic program is presented which seeks an optimal path through a series of decision periods, when each period begins with the choice of keeping an aircraft, reworking it before further operation, or buying a new one. The authors, do not consider changes in technology. Therefore, when a replacement does occur, it is made with a similar aircraft. Multivariate statistical techniques are used to estimate the relevant costs as a function of age, and time since last rework. Author (GRA)

N72-21032# Naval Postgraduate School, Monterey, Calif.
**PROGRAMMED PILOTAGE AS A MEANS OF IMPROVING ROTORCRAFT PERFORMANCE IN LEVEL FLIGHT M.S. Thesis**
Robert Alan Wildman Sep. 1971 48 p refs
(AD-736537) Avail: NTIS CSCL 01/3

Airframe drag reduction and engine duct design, while necessary to the improvement of performance, cannot alone offset the aerodynamic limitations inherent in rotary wing flight. The latter, which have become predominant with the advent of high output turboshaft engines must then be overcome by other means discussed in this paper. Programmed pilotage techniques which utilize real-time flight data to vary aerodynamic parameters are investigated and incorporated in the preliminary design of a high-speed rotor craft. The rotor speed and the contribution of lift from a fixed wing are thus optimized throughout the flight envelope, thereby greatly enhancing level flight speed characteristics. Author (GRA)

# 03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines, hydraulic, pneumatic and electrical systems; actuators, and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

**N72-21033*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**SOLAR ARRAY COST REDUCTION**
D. T. Bernatowicz 1972 11 p Proposed for presentation at 25th Power Sources Symp., Atlantic City, 23-25 May 1972; Sponsored by USAMC
(NASA-TM-X-68035; E-6859) Avail: NTIS CSCL 10A

A brief description is given of the cost of solar power systems over the last decade and means by which cost reductions may be achieved in the future. Costs were broken down into nonrecurring and recurring costs for solar array, battery, and power conditioning. Correlation of costs with power were poor; however, costs correlated reasonably well with the array area. E.H.W.

**N72-21034*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**A VERSATILE SILVER OXIDE-ZINC BATTERY FOR SYNCHRONOUS ORBIT AND PLANETARY MISSIONS**
Harvey J. Schwartz and Daniel G. Soltis 1972 23 p refs Proposed for presentation at 8th Intern. Elec. Power Sources Symp., Brighton, England, 26-28 Sep. 1972; Sponsored by Joint Services Elec. Power Sources Comm.
(NASA-TM-X-68036; E-6861) Avail: NTIS CSCL 10C

A new kind of silver-zinc cell was developed and tested under NASA support which can withstand severe heat sterilization requirements and does not display the traditional life limiting aspect of sinc electrodes i.e. shape change. These cells could be used on planetary lander mission which require wet-stand periods of over a year, a modest number of cycles (400 to 500) and may require dry heat sterilization. The weight advantage of these cells over the traditional nickel cadmium batteries also makes it an attractive alternative for synchronous orbit service where 400 to 500 cycles would be required over a 5 year period. Author

**N72-21035*#** Scientific Translation Service, Santa Barbara, Calif.
**STUDIES ON SOLID ELECTROLYTE CELL PART 3: THE SOLID ELECTROLYTE CELL WITH Ag3SI THIN FILM**
O. Yamamoto and T. Takahashi Washington NASA Mar. 1972 20 p refs Transl. into ENGLISH from Denki Kagaku (Tokyo), v. 34 1966 p 833-838
(Contract NASw-2035)
(NASA-TT-F-14196) Avail: NTIS CSCL 10A

By heating silver plates at about 200 C in a mixed stream of both hydrogen sulfide and air, a film of silver sulfide was synthesized on the silver plates. These samples were treated in an iodine atmosphere, and a silver iodide layer was synthesized on the surface. After this, they were heated in a nitrogen stream at a temperature of 300 to 359 C, and Ag3SI of 10 to 20 microns was synthesized. Cells were trial manufactured using thin Ag3SI films synthesized by the above-mentioned method as the electrolyte, using silver plates as the cathode, and using a mixture of iodine and acetylene black as the anode. Their discharge characteristics were measured. Author

**N72-21036#** Battelle Memorial Inst., Columbus, Ohio.
**LITHIUM BATTERY DEVELOPMENT Final Report**
Donald E. Semones and John McCallum Sep. 1971 66 p refs
(Contract F33615-68-C-1282; AF Proj. 3145)
(AD-735269; BATT-8917-F; AFAPL-TR-71-82) Avail: NTIS CSCL 10/3

The objective of the described research was to provide improved electrolytes and electrodes for rechargeable, nonaqueous lithium batteries. The electrolyte is a conductive propylene carbonate-thiocyanate salt which can be used in combination with metal thiocyanate positive electrodes. Nickel thiocyanate electrodes were fabricated. The best cell performance showed a need for lowered weight of electrolyte and electrode supporting structures. Studies on battery separator materials uncovered a polypropylene separator film that showed promise for use in the organic electrolytes. In an attempt to lower the weights of all components compared with previous cells, thin cells were also built that used ultra-thin nickel screen electrode supports and separators less than 1-mill thick. GRA

**N72-21037#** Dayton Univ., Ohio.
**AN EXPERIMENTAL INVESTIGATION OF COOLING A HIGH RATE NICKEL-CADMIUM BATTERY WITH AN INTERCELL PLANAR HEAT PIPE Technical Report, Sep. - Dec. 1970**
Edward T. Mahefkey, Jr. and Marshall Kreitman Wright-Patterson AFB, Ohio AFAPL Sep. 1971 30 p refs
(Contract F33615-67-C-1027; AF Proj. 3145)
(AD-735736; AFAPL-TR-71-40) Avail: NTIS CSCL 10/3

The purpose of the research was to investigate the passive thermal control afforded a battery by the heat pipe. Heat pipes are being considered for thermal control of spacecraft batteries, both as intercell and as battery base plate-to-space radiator heat transfer devices. The report describes the use of a planar (rectangular cross section) stainless steel - water heat pipe as an intercell heat transfer device to cool high-rate nickel-cadmium battery cells. Passive thermal control of battery (cell) temperature was demonstrated and performance of the heat-pipe-cooled cells was compared to that of uncooled cells and cells cooled with a metallic aluminum intercell fin. GRA

**N72-21038#** Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
**SEAWATER BATTERY EXPERIMENTS**
J. P. Wagner Dec. 1971 76 p refs
(Contract N00017-72-C-4401)
(AD-735864; APL-TG-1176) Avail: NTIS CSCL 10/3

Results from an experimental study pertaining to the development of a high energy density seawater battery are presented. In the initial phase of the study, cell orientation, cell geometry, electrode structure, and salinity effects were examined as to their effects on the current versus time characteristics and the electromotive force. In the second phase, injection of nonreacting (nitrogen) and reacting (oxygen and chlorine) gases through the porous cathodes was investigated. Nitrogen had only a slight effect on increasing cell performance. Battery reaction mechanisms are discussed from an inductive viewpoint based on the Nernst equation and also from the theory of charge transport in ionic solutions. The feasibility of employing the chlorine seawater battery for underwater applications is also discussed.
Author (GRA)

**N72-21039#** Argonne National Lab., Ill. Chemical Engineering Div.
**DEVELOPMENT OF HIGH-ENERGY BATTERIES FOR ELECTRIC VEHICLES Progress Report, Jul. 1970 - Jun. 1971**
E. J. Cairns, R. K. Steunenberg, J. P. Ackerman, B. A. Feay, D. M. Gruen, M. L. Kyle, T. W. Latimer, J. N. Mundy, R. Rubischko, H. Shimotake et al Jul. 1971 98 p refs Sponsored by AEC
(PB-205254; APTD-0875) Avail: NTIS CSCL 10C

The objective is to develop the technology required to construct secondary batteries having the performance capabilities required for pollution-free electric automobiles. Lithium/sulfur cells using a molten lithium halide-containing electrolyte and operating at 360 to 390 C have achieved capacity densities of up to 0.52 A-hr/sq cm(above 1 V) at a current density of 0.52 A/sq cm. The solubility of cathode materials in various electrolytes

and the identity of the soluble species are studied. Preliminary results indicate that electrolytes containing only fluoride and chloride anions have the lowest solubility for sulfur-bearing species. A survey of candidate solid electrolytes has led to the investigation of the lithium form of B-alumina. Author (GRA)

N72-21040# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
**CONTROL EXPERIMENTS ON ACTIVE MATERIAL MIGRATION IN ZINC ELECTRODES**
John J. Lander and James E. Cooper Oct. 1971 48 p refs
(AF Proj. 3145)
(AD-736016; AFAPL-TR-71-32) Avail: NTIS CSCL 10/3

Failure of zinc-oxide secondary batteries during cycle life testing occurs either by metallic zinc and silver penetrating the separator material between the plates or by shape change of the zinc electrode. In the latter process, the zinc active material in standard cell designs migrates from the top and sides of the plate toward the center and bottom. The report is concerned with efforts to test an idea that if more uniform current density distribution could be achieved, then the shape change process might be substantially slowed down or, perhaps, eliminated. A total of ten design variations of the Zn-AgO cell were fabricated and repetitively cycled to determine the influence of design variation on shape change of the zinc electrode active material. Results for four variations are reported in detail. Quantitative procedures for measurement of current density distribution are required to enable conclusive assessment to achieve improved cycle life by control of shape change. GRA

N72-21847*# Bell Telephone Labs., Inc., Murray Hill, N.J.
**SOLAR PROTON RADIATION DAMAGE OF SOLAR CELLS AT SYNCHRONOUS ALTITUDES**
L. J. Lanzerotti *In its* Reduction and Analysis of Particle Data from IMP F (Explorer 34) and IMP G (Explorer 41) 31 Dec. 1971 2 p refs (See N72-21831 12-29)
Avail: NTIS CSCL 10A

# 04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N72-21041*# Colorado State Univ., Fort Collins.
**METABOLIC EFFECTS OF ARTIFICIAL ENVIRONMENTS Semiannual Status Report**
John Patrick Jordan 31 Oct. 1971 40 p refs
(Grant NGR-06-002-075)
(NASA-CR-62079) Avail: NTIS CSCL 06C

The mechanisms by which inert gases influence metabolism were investigated from several viewpoints. Groups of rats were exposed at the thermal neutral temperature of the respective mixtures, to normoxic (P sub A 02 = 100 mm Hq) environments with argon, helium or nitrogen as the diluent at a total pressure of one atmosphere. The possible influence of diluent gases on oxygen transport to the cell was examined with hypoxic (P sub A 02 = 70 mm Hg) mixtures of the same diluent gases. Metabolic measurements included food, water, and oxygen consumption, CO2 production, hematocrit and the rate C-14O2 of expiration subsequent to intraperitoneal injection of acetate-1-C-14 or glucose UL-C-14. Argon-exposed animals showed a consistently decreased metabolic rate while, on the other hand, helium-exposed rats did not significantly alter metabolic rate relative to nitrogen. Certain indices, including acetate and glucose utilization, suggested that helium attenuated the imposed hypoxia at the cellular level while argon facilitated it as compared with nitrogen. These results suggest that metabolic influence of helium is largely thermal in nature while argon has a significant direct metabolic effect and that diluent gases may selectively influence oxygen availability to the interior of the cell. Author

N72-21042*# Fechtran Corp., Glen Burnie, Md.
**A MICROMETHOD FOR RAPID AND SPECIFIC SERIES DETERMINATION OF THE PROTEIN CONTENT OF INTACT MICROORGANISMS**
G. Hesse, R. Lindner, and R. Mueller Washington NASA Apr. 1972 14 p refs Transl. into ENGLISH from Z. Allg. Mikrobiol. (East Germany), v. 11, no. 7, 1971 p 585-594
(Contract NASw-2037)
(NASA-TT-F-14253) Avail: NTIS CSCL 06M

A method is described which makes it possible to determine in series fashion the absolute protein content in intact microorganisms. Yeasts were used as the material for developing and discussing the method; however, bacteria, cell organelles, fungoid spores, etc. may be studied without modification of the method. Samples with a dry mass of 25 microgram to 200 microgram were placed on filter paper squares, fixed by extraction and stained with bromphenol blue. The extinction of the elutriated dye was measured spectrophotometrically and found to be 598 nm. The color yield of the coloration is nearly linearly dependent on the mass of protein and independent of its structure and amino acid composition. Comparative studies using classical protein-determination methods (total nitrogen, protein nitrogen, amino acids following total hydrolysis) confirmed the protein values obtained using the dye method. Scattered light measurements in a methanol/water dispersion medium was used for dry weight determination of the smallest amounts of sample (removal of a small amount for inoculation from distinct colonies). The quantity of free amino acids is significantly lower in protein-rich yeasts than in protein-poor species. On the other hand, the amount of non-protein nitrogen was approximately the same in all of the investigated strains. Author

N72-21043# Joint Publications Research Service, Arlington, Va.
**SPACE BIOLOGY AND MEDICINE, VOLUME 6, NUMBER 1, 1972**
12 Apr. 1972 145 p refs Transl. into ENGLISH from Kosmicheskaya Biologiya i Meditsina (Moscow), v. 6, no. 1, 1972 p 3-93
(JPRS-55687) Avail: NTIS

Concerning the selection and training of cosmonauts; evaluation and analysis of accumulated data to facilitate the on-going transition from orbital to interplanetary flights; research aimed at guaranteeing safety on long flights and reliability of the human component of the man-spaceship system; space psychology and physiology; environmental problems and control (spacecraft habitability, effects of radiation and weightlessness, etc.) and telemetry, are presented. Author

N72-21044# Joint Publications Research Service, Arlington, Va.
**EFFECTS OF HYPEROXIA ON COAGULATING AND ANTICOAGULATING SYSTEMS IN BLOOD**
N. A. Agadzhanyan and B. K. Rybakov 28 Mar. 1972 9 p refs Transl. into ENGLISH from Eksperim. Khirurgiya i Anesteziologiya (Moscow), no. 6, Nov. - Dec. 1971 p 66-70
(JPRS-55553) Avail: NTIS

The effects of prolonged exposure to oxygen enriched atmospheres on the coagulating activity of human blood are investigated. Tests were also made to determine when changes develop in the coagulating process. The results demonstrate that during a prolonged stay in a hyperoxic environment, blood coagulability changes in the direction of hypocoagulability. The degree to which the changes occur depend on exposure to partial oxygen pressure and the duration of the exposure to the hyperoxic atmosphere. E.H.W.

N72-21045*# Translation Consultants, Ltd., Arlington, Va.
**EXPERIMENTAL AND CLINICAL STUDIES IN THE TREATMENT OF ARRHYTHMIAS DUE TO DIGITALIS BY SODIUM CITRATE**

W. Smolarz, S. Kosmider, and K. Zajusz Washington NASA Apr. 1972 9 p refs Transl. into ENGLISH from Z. Kreislaufforsch. (Berlin), v. 55, no. 5, 1966 p 521-527
(Contract NASw-2038)
(NASA-TT-F-14194) Avail: NTIS CSCL 06E

Cardiac arrhythmia caused by intravenously administered digoxin (0.15 mg/kg) into dogs was terminated by subsequent intravenous injections of Na citrate (0.6-1.4 g) alone or in combination with 0.5 g KC1. The best results were obtained giving Na citrate alone, for although positive results could be obtained at a lower dosage with the administration of the 2 compounds together, ventricular flutter appeared in several cases. The intravenous infusion of Na citrate (1.22 g) to patients with cardiac arrhythmia due to digitalis produced normalization of the rhythm in all patients observed; however, infusions of Na citrate had to be repeated in some cases due to remission of the rhythm disturbance. The use of Na citrate in the treatment of acute digitalis toxicity was suggested. Author

**N72-21046*#** Techtran Corp., Glen Burnie, Md.
**CHANGES IN THE NERVOUS SYSTEM DURING A 120 DAY CLINOSTATIC HYPOKINESIA AND THE PROPHYLAXIS OF HYPOKINESIC DISORDERS**
T. N. Krupina and A. Ya. Tizul Washington NASA Apr. 1972 13 p refs Transl. into ENGLISH from Zh. Nevropatol. i Psikhiatr. (Moscow), v. 71, no. 11, 1971 p 1611-1617
(Contract NASw-2037)
(NASA-TT-F-14225) Avail: NTIS CSCL 06S

The basic changes in the nervous system during a 120 day clinostatic hypokinesia are studied along with the effect of certain pharmocological preparations (pituitrin, deoxicortical steroid acetate, and nerabol) in the dynamics of hypokinesic disorders. Ten neurologically healthy men, ages 21 to 44, were test subjects; they were divided into three groups, one being a control group receiving no medication. As the experiment progressed there was an increase in the vegetative-vascular, electrolytic-humoral disorders and asthenization of the organism as well as a reduction in muscular tone, especially of the knee and femur. A gradual increase in neurological disturbances was observed towards the end of the third month and the beginning of the fourth. Most of the hypokinesic disturbances disappeared by the end of the second month following completion of the period of hypokinesia. It was concluded that certain pharmacological agents can be used to prevent hypokinesic disorders.
Author

**N72-21047*#** Exotech, Inc., Washington, D.C.
**CONTAMINATION CONTROL THROUGH FILTRATION OF MICROORGANISMS**
P. D. Stabekis and R. G. Lyle Apr. 1972 32 p refs
(Contract NASw-2062)
(NASA-CR-126035; TR-72-10) Avail: NTIS CSCL 06M

A description is given of the various kinds of gas and liquid filters used in decontamination and sterilization procedures. Also discussed are filtration mechanisms, characteristics of filter materials, and the factors affecting filter performance. Summaries are included for filter testing and evaluation techniques and the possible application of the filters to spacecraft sterilization.
Author

**N72-21048*#** Exotech, Inc., Washington, D.C.
**CONTAMINATION CONTROL BY USE OF ETHYLENE OXIDE**
R. H. Stroud and R. G. Lyle Apr. 1972 42 p refs
(Contract NASw-2062)
(NASA-CR-126034; TR-72-11) Avail: NTIS CSCL 06M

The uses of ethylene oxide as a decontaminating agent for planetary quarantine related applications are reported. Aspects discussed include: applications and limitations, chemical and physical properties, germicidal activity, methods of applications, and effects on personnel. F.O.S.

**N72-21049*#** Exotech, Inc., Washington, D.C.
**PLANNING, EVALUATION AND ANALYTICAL STUDIES IN PLANETARY QUARANTINE AND SPACECRAFT STERILIZATION Final Report**
Mar. 1972 34 p
(Contract NASw-2062)
(NASA-CR-126033; TR-72-15) Avail: NTIS CSCL 06M

The technical and analytical support used to aid in developing requirements for planetary quarantine are presented. The investigation was divided into 8 work tasks which are presented in tabular form. Data include methods of sterilization, safety margins for quarantine, revision of contamination logs for Mars and Venus, and estimates of encapsulated and 'free' microbial burden. E.H.W.

**N72-21050*#** Exotech, Inc., Washington, D.C.
**SAFETY MARGINS IN THE IMPLEMENTATION OF PLANETARY QUARANTINE REQUIREMENTS Interim Report**
Samuel Schalkowsky and Itzhak Jacoby Apr. 1972 26 p
(Contract NASw-2062)
(NASA-CR-126032; TR-72-14) Avail: NTIS CSCL 06M

The formulation of planetary quarantine requirements, and their implementation as determined by a risk allocation model, is discussed. The model defines control safety margins with particular emphasis on utility in achieving the desired minimization of excessive margins, and their effect on implementation procedures. E.H.W.

**N72-21051#** Royal Aircraft Establishment, Farnborough (England).
**THE EFFECT OF VIBRATION ON THE HUMAN BODY**
V. P. Grebenyuk Jul. 1971 7 p Transl. into ENGLISH Zdravookhr Kaz. (USSR), v. 12, 1969 p 14-16
(RAE-Lib-Trans-1611; BR-28526) Avail: NTIS

Vibration sickness in workers using vibro-thickeners for the construction of ferro-concrete panels is reported, with emphasis on the effects on feet and ankles due to standing on the vibrating machinery. Clinical treatment of the condition is described. Re-positioning the vibro-thickeners so that workers need not stand on them, and adding vibration insulating material sharply reduced the incidence of vibration and other sickness.
Author

**N72-21052*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**AUTOMATIC REAL-TIME PAIR FEEDING SYSTEM FOR ANIMALS Patent Application**
Henry A. Leon, James P. Connolly, Maurice J. Hitchman, and John E. Humbert, inventors (to NASA) Filed 30 Nov. 1971 19 p
(NASA-Case-ARC-10302-1; US-Patent-Appl-SN-203271) Avail: NTIS CSCL 06C

A pair-feeding method and apparatus are provided for experimental animals where the amount of food consumed by the experimental animal is immediately delivered to a normal or control animal so that there is a qualitative, quantitative, and chronological correctness in the pair-feeding of the two animals. Also provided is a feeding mechanism for delivering precisely measured amounts of food to a feeder. Circuitry is provided between master and slave feeders so that there is virtually no chance of a malfunction of the feeding apparatus, causing erratic results. Recording equipment is also provided so that an hourly record is kept of food delivery. NASA

**N72-21053#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Bad Godesberg (West Germany). Inst. fuer Flugmedizin.
**THE RELATIONSHIP OF OXYGEN UPTAKE AND BODY TEMPERATURE IN MAN IN ACUTE AND SEVERE HYPOXIA**
H. W. Holtmann, H. Bruener, and K. E. Klein 4 Aug. 1971

37 p refs In GERMAN; ENGLISH summary
(DLR-FB-71-65) Avail: NTIS; DFVLR, Porz-Wahn 15, 30 DM

In ten healthy students (20 to 30 years of age), the responses of ventilation parameters, pulse rate, O2-uptake, and body temperature were studied in a decompression chamber at atmospheric pressures of 750, 358, 335 and 312 mm Hg. The results showed significant changes of ventilation parameters (up to a maximum of + 87%) and pulse rate (up to a maximum of + 54%) in proportion to the different decompression levels. With increasing hypoxic stress the alterations of respiratory and circulatory values became more significant and concordant. In addition, the oxygen uptake revealed dependence from the different inspiratory partial oxygen pressures. The control experiments at 750 mm Hg suggest a significant dependence of oxygen uptake from the test situation itself. This fact was taken into consideration in the evaluation of the results obtained at different altitudes. The continuous registration of oxygen uptake during hypoxia shows a primary decrease which is followed by an increase, so that oxygen consumption is finally higher than the level at rest. O2-uptake seems to approach an equilibrium, but at the end of the 30-minutes test period is not yet in a steady state. The curves for body temperature and oxygen uptake show inverse courses which point to the existence of control systems. Author

**N72-21054#** Lovelace Foundation for Medical Education and Research, Albuquerque, N.Mex.
**THE BIODYNAMICS OF AIRBLAST**
Clayton S. White, Robert K. Jones, Edward K. Damon, E. Royce Fletcher, and Donald R. Richmond 1 Jul. 1971 135 p refs Presented at the Symp. on Linear Acceleration of the Impact Type, Porto, Portugal, 23-26 Jun. 1971
(Contract DASA01-70-C-0075)
(AD-734208; DNA-2738T) Avail: NTIS CSCL 06/19

After pointing out that accelerative and decelerative events are associated with the direct (pressure) and indirect (translational events including penetrating and nonpenetrating debris and whole-body impact) effects of exposure to blast-induced winds and pressure variations, some of the relevant biophysical parameters were selectively noted and discussed. These included the pressure-time relationship; species differences; ambient pressure effects; the significance of positional (orientational) and geometric (situational) factors as they influence the wave form, the pressure dose and the biologic response; and data bearing upon the etiology of blast injury. The consequences of pressure-induced violent implosion of the body wall and the significance of the associated variations in the internal gas and fluid pressures were described and emphasized as were alternating phases of :forced: hemorrhage and arterial air embolization, fibrin thrombi, coagulation anomalies and renal, cardiac, and pulmonary sequelae. Tentative biomedical criteria consistent with recent interspecies scaling and modeling studies for assessing primary blast hazards were presented. Author (GRA)

**N72-21055#** Bristol Univ. (England). Dept. of Physiology.
**ANTARCTIC CLIMATE, CLOTHING AND ACCLIMATIZATION Final Report, 1 Sep. 1969 - 31 Mar. 1971**
A. F. Rogers and R. J. Sutherland Wright-Patterson AFB, Ohio AMRL Nov. 1971 143 p refs
(Grant EOOAR-0068-69; AF Proj. 7164)
(AD-734071; AMRL-TR-71-112) Avail: NTIS CSCL 06/19

A detailed computer analysis was made of the clothing worn by the members of the Trans-Antarctic Expedition, and the relevant climate data. The analysis covers a period of just over fourteen months and includes the 2,158 mile journey across Antarctica. The cold stress was severe. No evidence of whole body acclimatization to cold in man could be found. The clothing worn was clearly shown to be more closely correlated with temperature than with windchill. The measured clo values of twentyeight different assemblies of Antarctic clothing were compared. A simple direct relationship between a weighted number of layers count and the clo value of an assembly was shown to exist. This relationship is of immediate use in comparing the relative thermal insulation of two cold weather clothing assemblies. Other data, including weight fat thickness and sleep records, are discussed. The data presented are consistent with the suggestion that man creates and controls his own micro climate. Author (GRA)

**N72-21056#** Connecticut Univ., Storrs.
**SONAR DOPPLER DISCRIMINATION IN HIGH NOISE ENVIRONMENTS Interim Report**
Paul F. Smith (Naval Submarine Med. Center, Groton, Conn.) and Martha Koch 10 Feb. 1971 18 p refs
(Contract N00014-67-A-0197-0001)
(AD-734118; NAVMED-MF12.524.004-9010D) Avail: NTIS CSCL 05/10

The experiment was concerned with the ability of anti-submarine warfare helicopter-borne sonarmen to perform Doppler discrimination in the high background noise existing aboard rotary winged aircraft. Performance on a frequency discrimination task was measured under conditions in which the background noise was varied in intensity up to levels approaching those found aboard helicopters. The level of the signal was also varied such that under some conditions the signal was only slightly audible above the noise while under some conditions the signals were clearly audible. It was found that the intensity of the noise was not, of itself, related to the acuity of frequency discrimination. Rather, the differences between the signal level and noise level was most directly related to pitch discrimination performance. It was concluded that, if the signal level could be maintained well above the background noise level, doppler discrimination would not be seriously impaired. Author (GRA)

**N72-21057#** Naval Submarine Medical Center, Groton, Conn.
**BIOCHEMISTRY OF SUBMARINE AND DIVING STRESS. 1: LACTATE-PYRUVATE AND REDOX CHRONIC HYPERCAPNIA Interim Report**
Michael J. Jacey and Karl E. Schaefer 22 Feb. 1971 17 p refs
(AD-734120; NSMRL-652; NAVMED-MF12.524.006-9028B) Avail: NTIS CSCL 06/19

Lactate and pyruvate concentrations were measured in blood and various tissues of guinea pigs exposed to 15% CO2 in 21% O2, balance N2, for varying periods of time up to one week. Acute exposure resulted in reduction of lactate/pyruvate ratios (L/P) of blood, heart, and muscle but not liver. Blood L/P further decreased after one day of exposure and slowly increased during the chronic phase of respiratory acidosis. Heart L/P returned to control values by six hours while muscle L/P remained depressed for the duration of hypercapnia. Since L/P reflect the redox state of the free glycolytic nicotinamide-adenine dinucleotide couplet, the redox state, NAD(-)/NADH was calculated from the L/P and pH of blood for the various periods of hypercapnia. During acute hypercapnia NAD(-)/NADH increased in blood markedly indicating the existence of a more oxidized state during this period. Chronic hypercapnia returned blood NAD(-)/NADH toward initial values suggesting a normalization of glycolytic metabolism. The observed differences in L/P in the various tissues are apparently related to the different CO2 buffering capacities of tissues. Author (GRA)

**N72-21058#** Naval Submarine Medical Center, Groton, Conn.
**BIOCHEMISTRY OF SUBMARINE AND DIVING STRESS. 3: PLASMA CREATINE, CREATINE PHOSPHATE AND CREATINE PHOSPHOKINASE RESPONSES TO HYPERCAPNIA Interim Report**
Donald V. Tappan 14 Apr. 1971 14 p refs
(AD-734126; NSMRL-661; NAVMED-MF12.524.006-9028B) Avail: NTIS CSCL 06/19

Creatine phosphokinase, the enzyme which is currently the most sensitive tool for detecting myocardial infarction, has been shown to also be useful for the detection of serious or irreversible damage to animals exposed to stressful levels of environmental carbon dioxide. Since accumulation of carbon dioxide is a problem for which Navy divers must be constantly alert and which may affect workers in any confined environment,

this analysis is suggested as a clinical test for monitoring potential damage to the health of operational personnel.
Author (GRA)

**N72-21059#** Naval Submarine Medical Center, Groton, Conn.
**BIOCHEMISTRY OF SUBMARINE AND DIVING STRESS. 4: RESPONSES OF BLOOD LACTATE-PYRUVATE AND REDOX STATE TO CHRONIC EXPOSURE TO 3 PERCENT CO2 Interim Report**
Michael J. Jacey, Arthur A. Messier, and Karl E. Schaefer 15 Apr. 1971 11 p refs
(AD-734122; NSMRL-662; NAVMED-MF12.524.006-9028B) Avail: NTIS CSCL 06/19

Lactate and pyruvate concentrations were measured in blood of guinea pigs exposed to 3% CO2 in 21% O2, balance N2 for varying periods of time up to a week. The redox state, NAD-/NADH ratio was calculated from the lactate/pyruvate ratio and H(-) concentration for each time point. Blood lactate-pyruvate concentrations as well as redox states, were virtually unaffected. It would appear that a respiratory acidosis, induced by exposure to 3% CO2 with a maximum pH decrease of .12 units, is in itself not sufficient to alter glycolytic metabolism of blood in guinea pigs. Author (GRA)

**N72-21060#** Stanford Research Inst., Menlo Park, Calif.
**MATHEMATICAL ANALYSIS AND DESCRIPTION OF CONTINUOUS HUMAN BEHAVIOR Annual Status Report, 1 Nov. 1970 - 31 Oct. 1971**
Lawrence R. Pinney 20 Dec. 1971 7 p
(Contract N00014-71-C-0139; NR Proj. 145-270; SRI Proj. LSU-8961)
(AD-734681; ASR-1) Avail: NTIS CSCL 05/10

To record and analyze sequential (i.e. continuous) motor behavior in the human during performance of a task, a method is being devised whereby the relations of body units during spontaneous activity are measured using the angular displacement of each unit with respect to a reference body unit as a function of time. For any given sequence of behavior, the angular displacements are being reduced to linear differential equations. In addition, the sequences of behavior are being related to important physiological substrates such as brain function, cardiac output, muscle tension, respiration rate and volume, body temperature and the like. Author (GRA)

**N72-21061#** Texas Univ., Austin. Electronics Research Center.
**THE EXTRACTION OF SLEEP INFORMATION FROM HEART RATE DATA: ANALYSIS OF THE SLEEP CYCLE**
Joanne L. Aldredge, Ashley J. Welch, Philip C. Richardson, and Fred B. Vogt 5 Aug. 1971 128 p refs
(Contract F44620-71-C-0091; AF Proj. 4751)
(AD-734283; TR-107; AFOSR-71-2633-TR) Avail: NTIS CSCL 06/16

The report describes some of the characteristics of heart rate information during sleep and suggests the possibility of extracting sleep information from heart rate data. The average heart rate and variance of heart rate are presented on ten subjects during two nights of sleep using epochs of 128 consecutive R to R intervals recorded during known stages of sleep. The significance of these measures as indicators of sleep as a function of the sleep cycle in a night's sleep is computed using the Analysis of Variance. The hypothesis that the mathematical expected mean heart rate values for each sleep cycle (each approximately 90 minutes long (8)) of a particular night and stage are equal is rejected. Average variance of heart rate for each sleep cycle remained more constant throughout a night than did the mean averaged heart rate (the mean of the averaged heart rate values of each epoch for a cycle). In some cases, the mean averaged heart rate and average sample standard deviation values varied with each cycle according to certain increasing and decreasing trends. Author (GRA)

**N72-21062#** Arizona State Univ., Tempe.
**A RESEARCH PROGRAM ON HYPERBARIC ENVIRONMENTAL EFFECTS UPON PRIMATES AND OTHER ANIMALS Final Report**
Dwight Sutton and Eugene M. Taylor 1 Nov. 1971 25 p refs
(Contract N00014-68-A-0150; NR Proj. 196-077)
(AD-735117; Rept-71-F) Avail: NTIS CSCL 06/19

The contract developed and tested sensitive methodologies for measuring sensory and motor impairment in hyperbaric environments. The measures are generally applicable to various animal species, and their results are similarly generalizable.
Author (GRA)

**N72-21063#** Army Medical Research Lab., Fort Knox, Ky.
**VISUAL ACUITY UNDER CONDITIONS OF CHROMATIC DIFFERENCES WITHOUT DIFFERENCES IN LUMINANCE**
R. Hilz and C. R. Cavonius Apr. 1971 15 p refs Transl. into ENGLISH from Vision Research (London), v. 10, 1970 p 1393-1398
(AD-734931) Avail: NTIS CSCL 05/10

Visual acuity was measured for gratings in which alternate sets of bars differed in wavelength, but not in luminance. This chromatic acuity increases with increasing wavelength difference, but does not reach values as high as achromatic acuity, contrary to earlier reports. Author (GRA)

**N72-21064#** Howard Univ., Washington, D.C. Dept. of Physiology.
**EFFECTS OF ALTITUDE ON CELLULAR METABOLISM AND TERMINAL OXIDATION Final Report, 15 Apr. 1968 - 30 Jun. 1971**
Leslie C. Costello and Armand J. Gold Dec. 1971 27 p
(Grant DAHC19-70-C-0020; DA Proj. 2N0-61102-B-71-D)
(AD-734933; Rept-3) Avail: NTIS CSCL 06/9

The program was concerned with a study of the cellular metabolic effects of altitude exposure, particularly in relation to energy metabolism. The experimental conditions employed (18,000 or 25,000 feet exposure for 6-7 days) resulted in hypaphogia, weight loss, increased hematocrit, increased plasma pyruvate and plasma lactate. The hypophagic response indicated the need to include a food control group in these studies as well as a normal control. Altitude exposure did not alter cytochrome oxidase activity of kidney, liver, or heart mitochondria. Mitochondrial oxidative phophorylation was not imparied in liver or kidney mitochondria. Most significantly the respiratory capacity of kidney metochondria was markedly decreased in response to altitude exposure. Histological studies revealed pulmonary congestion, liver glycogen depletion, and increased adrenal cortical cytochrome oxidase activity occurring in altitude exposure. Author (GRA)

**N72-21065#** Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
**INVESTIGATION OF THE PRIMATE VESTIBULAR SYSTEM FUNCTION THROUGH ANALYSIS OF THE VESTIBULO-OCULAR REFLEX RESPONSE TO VARIOUS INPUT STIMULI**
Marvin H. Chasen, James W. Guthrie, Clyde R. Replogle, and Andrew M. Junker Aug. 1971 33 p refs
(AF Proj. 7222)
(AD-734545L; AMRL-TR-71-4) Avail: NTIS CSCL 06/19

An indirect measurement of dynamic responses of the primate vestibular system was obtained through the measurement of eyeball counterroll from six Rhesus monkeys. A control system was developed to provide three types of input stimuli. These stimuli consisted of constant speed rotations, pendular oscillations, and Gaussian random noise. The experimental data was analyzed by use of correlation functions, power spectral density functions, and probability densities. Results show that angular acceleration and the acceleration resulting from centripetal force affect the counterroll response. Gaussian noise position inputs failed to produce counterroll distributions that are Gaussian. However, because of the two acceleration inputs, this evidence

is not sufficient to conclude that the system is nonlinear. Suppression of response to random inputs was observed, indicating that suppression does not necessarily result from anticipation of the input as was suggested by previous investigators. Author (GRA)

**N72-21066#** School of Aerospace Medicine, Brooks AFB, Tex.
**BODY WEIGHT VARIATION IN PRIMATES EXPOSED TO 55 MeV PROTONS Final Report, Jan. 1965 - Sep. 1971**
John H. Kirk Nov. 1971 11 p refs
(AF Proj. 7757)
(AD-734779; SAM-TR-71-48) Avail: NTIS CSCL 06/18

Sham-exposed controls and 55-Mev-proton irradiated primates have been periodically weighed for 7 years following whole-body surface exposure. The primates exposed at the 400- and 600-rad levels have smaller body wieghts than the age- and sex-matched control primates. This finding indicates a possible chronic radiation effect. Author (GRA)

**N72-21067#** Naval Aerospace Medical Inst., Pensacola, Fla.
**SELECTED ANTHROPOMETRIC DIMENSIONS OF NAVAL AVIATION PERSONNEL**
William F. Moroney, Robert S. Kennedy, Edmund C. Gifford, and Joseph R. Provost 10 Aug. 1971 28 p refs
(AD-735101; NAMRL-1141; NAVMED-MF12.524.002-5012D) Avail: NTIS CSCL 06/14

Since the previous study of the anthropometric features of naval aircrewmen, the physical and academic requirements for entrance into the flight program have been changed. The present study was undertaken to determine whether these changes combine with changes in the anthropometric features of the population in general to influence certain anthropometric dimensions. The dimensions of the aviation training candidates in this study differed significantly from those reported in the other samples. Possible reasons for these differences include: growth of the population in general, characteristics of the samples involved, and different anthropometric and academic requirements for acceptance into the aviation training program. Author (GRA)

**N72-21068#** Naval Research Lab., Washington, D.C.
**BIOCIDAL PROPERTIES OF AN ANTI-ICING ADDITIVE Final Report**
N. I. Hendey, V. U. Bagdon, G. E. Ernst, D. E. Klemme, and J. M. Leonard 15 Nov. 1971 12 p refs
(NRL Proj. G04-01)
(AD-735451; NRL-7337) Avail: NTIS CSCL 06/13

Three laboratories collaborated in evaluating the fungicidal potency of an anti-icing additive for jet fuel. The material is more than 99% 2-methoxyethanol. The assay procedure was standardized by mutual agreement among the participants; the assay organism was Cladosporium resinae, the most common fungal contaminant of jet fuel. The results are in fairly good accord, and though the test was not intended to represent field conditions of use, the data indicate that the additive is lethal to the fungus at concentrations easily attainable in the various water bottoms of fuel-handling systems. Author (GRA)

**N72-21069#** Naval Air Development Center, Johnsville, Pa. Crew Systems Dept.
**ASSESSMENT OF TEMPERATURE RISE SUPPRESSION BY EDGE LOSSES DURING IRRADIATION Summary Report**
Alice M. Stoll 3 Dec. 1971 18 p refs
(AD-735881; NADC-CS-7104) Avail: NTIS CSCL 06/19

A method to be utilized for human skin protection is described for determining: (1) the minimum aperture size required to yield temperature rise data free from edge loss effects in measurements made at the center of a site during thermal irradiation of a semi-infinite solid; (2) the magnitude of edge losses due to restriction of the irradiated area to less than the 'no loss' size, and its variation with respect to irradiance level and exposure time; and (3) where the thermal properties of the material are known, the energy absorption rate. The latter, on comparison with the measured incident energy also yields a measure of the absorptivity of the materials. GRA

**N72-21070#** Bureau of Radiological Health, Rockville, Md. Div. of Electronic Products.
**KWIC INDEX TO BIOLOGICAL EFFECTS AND RELATED TECHNOLOGY OF LASERS AND LIGHT**
Anne M. Lutz, ed. Dec. 1971 532 p refs
(PB-205091) Avail: NTIS CSCL 06R

A key-world-in-context index and bibliography with author index to significant literature dealing with the biological effects and related technology of lasers and light are presented. Over 2000 references are cited. GRA

**N72-21071#** Naval Medical Research Inst., Bethesda, Md.
**BIBLIOGRAPHY OF REPORTED BIOLOGICAL PHENOMENA (EFFECTS), AND CLINICAL MANIFESTATIONS ATTRIBUTED TO MICROWAVE AND RADIO FREQUENCY RADIATION Medical Research Interim Report**
Zorach R. Glaser 4 Oct. 1971 99 p refs
(AD-734391; NAVMED-MF12.524.015-0004B) Avail: NTIS CSCL 06/18

More than 2100 references on the biological responses to radio frequency and microwave radiation, published up to September 1971, are included in the bibliography. Particular attention has been paid to the effects on man of non-ionizing radiation at these frequencies. The citations are arranged alphabetically by author, and contain as much information as possible so as to assure effective retrieval of the original documents. An outline of the effects which have been attributed to radio frequency and microwave radiation is also part of the report. Author (GRA)

**N72-21072#** Army Medical Research Lab., Fort Knox, Ky.
**THE PHYSICAL PERFORMANCE OF THE HYPERVENTILATOR Interim Report**
Andree J. LLoyd 16 Sep. 1971 16 p refs
(DA Proj. 3A0-61102-B-71-R)
(AD-734298; USAMRL-947) Avail: NTIS CSCL 06/16

The maximum voluntary endurance of an isometric muscle contraction was examined in three groups of subjects: chronic hyperventilators, a control group with voluntary hyperventilation, and a second control group. During each endurance session subjects were requested to estimate task related levels of pain on a five-point scale. Continuous surface electromyographic monitoring was made of the dominant muscle. The results indicated that individuals with a chronic hyperventilation syndrome were more efficient in the utilization of muscles during a strenuous physical task when measured by mean amplitudes of the electromyographic representation of neuromuscular activity. It was proposed that a therapeutic approach to the syndrome might incorporate strenuous exercise to the symptomatology of excessive breathing. Author (GRA)

**N72-21073#** Syracuse Univ., N.Y. Lab. of Sensory Communication.
**OPTIC AND AUDITORY NERVE AND PERCEPTION STUDIES Semiannual Research Report, 1 May - 1 Nov. 1971**
1 Nov. 1971 33 p refs
(Contract N00014-67-A-0378-0003; Grant NSF GB-8412)
(AD-734017; LSC-15) Avail: NTIS CSCL 06/16

Contents: Physiology of the Limulus Visual System; Conditioning of Limulus Behavior; Properties of Lateralization in the Intact Limulus Eye; A Mechanoreceptor on the Limulus Shell; Development of electronic neuron models; Short-term adaptation in single auditory neurons; Effect of contactor area on subjective magnitude functions; Loudness as a function of tone duration; Loudness effects in pairs of short sound bursts. GRA

# 05 BIOTECHNOLOGY

Includes life support systems, human engineering, protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

**N72-21074*#** General Electric Co., Philadelphia, Pa. Missile and Space Div.
**PRESSURE RAMP PROGRAMMER; IMBLMS PHASE B4 ADDITIONAL TASKS: TASK 3.0 PRESSURE RAMP PROGRAMMER Final Report**
G. L. Fogal and C. G. Reinhardt Jan. 1972 81 p
(Contract NAS9-10741)
(NASA-CR-115508; DOC-70SD5414) Avail: NTIS CSCL 06B

A pressure ramp programmer model was designed, fabricated and tested. This model, in conjunction with an automatic blood pressure monitor, automatically controls the pressure in the blood pressure monitor arterial cuff. The cuff pressurization cycle is designed to maximize accuracy and repeatability of blood pressure measurements. The key feature of this automatic cycle is rapid blood pressure cuff bleed down from an initial setting until systolic (diastolic) pressure is encountered followed by a short repressurization and slow bleed, long enough to permit accurate systolic (diastolic) pressure determination. The system includes a pressure reservoir which bleeds the cuff through a precision needle valve; a solenoid valve which permits rapid pressurization from the reservoir; and a pressure sensor which provides information for bleed rate and set point controls. Korotkoff sound signals from a micorphone in the blood pressure cuff (not part of the system) provide decision information to the digital control system. The system completed a series of engineering tests using simulated Korotkoff sound inputs. The system performed successfully in all cases and was stable over an extended period of time. Author

**N72-21075*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**RESULTS OF INTRAVEHICULAR MANNED CARGO-TRANSFER STUDIES IN SIMULATED WEIGHTLESSNESS**
Amos A. Spady, Jr., Gary P. Beasley, Kenneth R. Yenni, and Donn F. Eisele Washington Apr. 1972 30 p refs
(NASA-TN-D-6774; L-8099) Avail: NTIS CSCL 06S

A parametric investigation was conducted in a water immersion simulator to determine the effect of package mass, moment of inertia, and size on the ability of man to transfer cargo in simulated weightlessness. Results from this study indicate that packages with masses of at least 744 kg and moments of inertia of at least 386 kg-m2 can be manually handled and transferred satisfactorily under intravehicular conditions using either one- or two-rail motion aids. Data leading to the conclusions and discussions of test procedures and equipment are presented. Author

**N72-21076*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**MODIFICATION OF ONE MAN LIFE RAFT Patent Application**
Ernest J. Soter, inventor (to NASA) Filed 29 Oct. 1971 8 p
(NASA-Case-LAR-10241-1; US-Patent-Appl-SN-193672) Avail: NTIS CSCL 06K

A detailed description is given of a one man life raft that maintains its inflatability and flotation properties after a puncture of the main wall. The peripheral tube is divided by an airtight fabric bulkhead so that when either section of the tube is punctured, the bulkhead moves into the section. The raft is constructed so that either side can be the up side. E.H.W.

**N72-21077#** Federal Aviation Administration, Washington, D.C. Office of Aviation Medicine.
**THE BENEFITS OF THE USE OF SHOULDER HARNESSES IN GENERAL AVIATION AIRCRAFT**
Joseph A. Sirkis Feb. 1972 7 p refs
(FAA-AM-72-3) Avail: NTIS

The installation and use of shoulder harnesses is a practical and relatively inexpensive solution to the problem of maintaining separation between man and machine during an aircraft crash sequence. The addition of shoulder harness to the tiedown chain of the general aviation aircraft occupant will increase the probability of the user surviving a severe crash and minimize injuries resulting from light-to-moderate crashes. It is concluded that if shoulder harnesses were installed in all general aviation aircraft, considerable benefit to the users of these harnesses would accrue. The user-occupant of older general aviation aircraft would realize a level of safety approaching that enjoyed by the user-occupant of normal utility, or acrobatic category airplanes manufactured under Approved Type Certificates applied for after September 14, 1969. Author

**N72-21078#** Federal Aviation Administration, Washington, D.C.
**EFFECTIVENESS OF RESTRAINT EQUIPMENT IN ENCLOSED AREAS**
D. L. Lowrey, E. D. Langston, W. Reed, and John J. Swearingen Feb. 1972 30 p refs
(FAA Proj. AM-A-71-PRS-37)
(FAA-AM-72-6) Avail: NTIS

A series of 20-g decelerations of a crash sled was conducted to determine the magnitude of head impact decelerations while wearing various types of restraint equipment in small confined areas. Restraint webbing loads and head impact decelerations are presented for three directions of impact (straight forward, and 90 degrees to left and right). Restraint webbing undoubtedly reduces head impact velocities, especially in the forward direction. However, this study shows that, in most instances, head strikes may be expected even while using upper and lower torso restraint because of the close proximity of surrounding structure in general aviation aircraft. Introduction of upper torso restraint along with lap belts in general aviation aircraft will not relieve the need for delethalizing surrounding structures. Author

**N72-21079*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**VISUAL EXAMINATION APPARATUS Patent Application**
Richard F. Haines, James W. Fitzgerald, and Salvadore A. Rositano, inventors (to NASA) Filed 6 Jul. 1971 22 p
(NASA-Case-ARC-10329-1; US-Patent-Appl-SN-159857) Avail: NTIS CSCL 06B

An automated visual examination apparatus, for measuring visual sensitivity and mapping blind spot size, shape and position, is described. The system has a projection system for displaying to a patient a series of visual stimuli, a response switch enabling him to indicate his reaction to the stimuli, and a recording system responsive to both the visual stimuli and the patient's response. The recording system provides a correlated permanent record of stimuli and response from which a substantative and readily apparent visual evaluation can be made. NASA

**N72-21080#** Human Resources Research Organization, Alexandria, Va.
**SYSTEMS ENGINEERING OF COAST GUARD AVIATOR TRAINING**
Eugene R. Hall and Paul W. Caro Aug. 1971 10 p refs Presented at the Psychology in the Air Force Symp., Colo. Springs, Colo., Apr. 1971
(Contract DOT-CG-2310-A)
(AD-735051; HumRRO-PP-17-71) Avail: NTIS CSCL 05/9

The paper describes a total-program application of the systems engineering concept to the U.S. Coast Guard aviation training programs. The systems approach used treats all aspects of the training to produce the most cost-effective integration of academic, synthetic, and flight training for the production of graduate Coast Guard aviators. The paper describes the techniques

used to develop job-relevant terminal behavioral objectives (the Coast Guard search and rescue flight mission provides the operational context); the assignment of objectives to academic, synthetic, and flight training; the integration of these components into a systems-engineered training program; the development of relatively objective proficiency assessment techniques; and the development of a flying training quality control system for maintaining and enhancing instructional efficiency and for management of the training system. Author (GRA)

**N72-21081#** International Business Machines Corp., Gaithersburg, Md. Federal Systems Div.
**AIRWAY RESISTANCE MEASUREMENT AT DEPTH Final Report**
Stephen B. Cades and Morton R. Kagan 17 Jan. 1972 107 p refs
(AD-735462; FSC-72-5010) Avail: NTIS CSCL 06/2

The report discusses the design and development of a whole body plethysmograph system intended for ultimate use as a means of measuring airway resistance under ambient hyperbaric conditions for normal breathing patterns. A customer supplied plenthysmograph was greatly modified towards achieving this goal. At present the plethysmograph can be used to make measurements of airway resistance for any breathing patterns at BTPS conditions. A computer program has been written which provides automatic correction of the data for a pressure/flow lag. In addition, the program includes compensation techniques (requiring additional validation) which should allow data obtained at ambient conditions to be utilized. The hardware design and modifications are discussed with respect to the guidelines used, the approach taken, and the design achieved. The operational use of the system is described in the sections concerning installation and calibration, operating procedures, data analysis techniques and the computer program. Present capabilities, potential error sources, and specific recommendations round out the project description. Author (GRA)

**N72-21082#** Navy Clothing and Textile Research Unit, Natick, Mass.
**DEVELOPMENT AND EVALUATION OF AN OXYGEN-SENSING WARNING DEVICE**
Norman F. Audet and George M. Orner Dec. 1971 33 p refs
(AD-735377; TR-98; Rept-6-71) Avail: NTIS CSCL 06/11

The Navy Clothing and Textile Research Unit has evaluated an oxygen-sensing warning device, developed by Beckman Instruments, Inc., to be used as a safety feature in a Damage Control Suit System (DCSS) presently under development. The O2 warning device, which employs a polarographic oxygen sensor in conjunction with control electronics and a visual output, provides a visual warning in the event oxygen concentrations in the DCSS are above or below certain preselected thresholds. GRA

**N72-21083#** American Optical Co., Southbridge, Mass. Central Research Lab.
**RESEARCH AND DEVELOPMENT OF AN OCULAR LASER PROTECTIVE FILTER Final Report, Jul. 1969 - Mar. 1971**
Richard F. Woodcock and Richard J. Hovey Brooks AFB, Tex. School of Aerospace Med. Jul. 1971 41 p
(Contract F41609-69-C-0050; AF Proj. 7784)
(AD-735799; SAM-CR-71-3) Avail: NTIS CSCL 06/17

The goal of this work was the development of an ocular filter for protection against laser radiation. For its ideal imbodiment this filter must possess an optical density of 3.5 or greater for all laser wavelengths and have a luminous transmission of 60 percent or better. Because the wearer must be able to identify color coding, the filter must have narrow band absorption at the laser wavelengths and suitable transmitting windows throughout the visible region. Research was carried out on Cu-containing plastic materials with broad band absorption in the blue and near infrared regions of the optical spectrum and on glass materials with appropriate narrow band absorption throughout the visible spectrum provide by Er-3(+) and absorption in adjacent spectral regions provided by Ce, Cu, or Fe or combinations thereof. Author (GRA)

**N72-21084#** Naval Air Development Center, Johnsville, Pa.
**PORTABLE DETECTOR OF LOW AMPLITUDE ELECTRO-CARDIOGRAPHIC ACTIVITY**
George E. Bergey, William J. Miller, and Russell D. Squires 28 Oct. 1971 20 p ref
(AD-735882; NADC-CS-7110) Avail: NTIS CSCL 06/2

A portable instrument is described which quickly indicates the presence or absence of myocardial activity. The instrument consists of two probes connected by a flexible retractible coiled cable. The stainless steel tips of each probe constitute the input connections of the enclosed circuitry and, in use, are placed in contact with the skin on the precordium. The electrical signal present between probe tips is processed by a network of filter, trigger, and logic circuits, the result of which is a bright flash of a light-emitting diode for each ORS complex present at the input. Because of its simplicity of operation, this device could easily be used by paramedical personnel as well as physicians in a variety of emergency situations. Author (GRA)

**N72-21085#** National Aviation Facilities Experimental Center, Atlantic City, N.J.
**THE DEVELOPMENT OF A MOTION PICTURE MEASUREMENT INSTRUMENT FOR APTITUDE FOR AIR TRAFFIC CONTROL Final Report, Nov. 1970 - Nov. 1971**
E. P. Buckley and Tom Beebe Jan. 1972 34 p refs
(AD-735942; FAA-NA-72-7; FAA-RD-71-106) Avail: NTIS CSCL 15/5

A motion picture test for aptitude for air traffic control was developed and pretested with 19 air traffic control specialists. The test was developed at the National Aviation Facilities Experimental Center (NAFEC) during this project for use in a project being conducted for Federal Aviation Administration by Education and Public Affairs (EPA). That project report will contain data on use of the test with a much larger sample. This report describes the test and gives estimates of reliability and validity as obtained from the administration of the test to the above-mentioned sample of 19 air traffic control specialists. Author (GRA)

**N72-21086#** Thermo Electron Engineering Corp., Waltham, Mass.
**VAPOR CYCLE ENERGY SYSTEM FOR IMPLANTABLE CIRCULATORY ASSIST DEVICES Annual Progress Report, Jun. 1970 - Jun. 1971**
F. N. Huffman and K. Hagan Aug. 1971 285 p refs
(Contract PH-43-68-1455-3)
(PB-205474; TE4100-6-72; PH-43-68-1455-3) Avail: NTIS CSCL 06L

A description is given of the development status of a heart assist system driven by an electronically-controlled tidal regenerator engine (TRE) which contains neither valves nor sliding seals. The TRE pressurization (typically from 5-160 psia) is controlled by a displacer piston actuated by a latching binary solenoid. The electrical power of the sensor, electronic logic and solenoid is interposed between the superheater and the boiler. A power condition unit provides the proper potential levels. The TRE is directly coupled to an assist blood pump which also acts as a blood-cooled heat exchanger, pressure-volume transformer and sensor for the electronic logic. GRA

**N72-21087#** School of Aerospace Medicine, Brooks AFB, Tex.
**A PORTABLE, SELF-CONTAINED DIGITAL THERMOMETER Final Report, Feb. - Sep. 1969**
Wendell R. Peters Jan. 1972 17 p Submitted for publication
(AF Proj. 7996)
(AD-735662; SAM-TR-72-2) Avail: NTIS CSCL 06/12

The digital thermometer was designed and developed in response to an Air Force requirement for a special multipurpose thermometer. The instrument is 3 in. wide, 4.5 in. long, and 1

in. thick. It weighs 13 oz. including the self-contained silver zinc batteries. One temperature range incorporated in the unit measures temperatures from 32 to 212 F., with an accuracy of 1 degree. The second range measures oral temperatures from 95 to 105 F., with 0.1 degree accuracy. A number of interchangeable temperature sensors are available for measuring oral or skin temperature, air temperature, liquid temperature, and the temperature of metal surfaces. The time required to take an oral measurement is less than 1 minute. Immediate, accurate readout of temperature is possible because of the digital feature. The thermometer, because of its portability, size, accuracy, and fast readout, holds potential promise for use as a general instrument for clinical medicine. Author (GRA)

**N72-21088#** Stanford Univ., Calif.
**OPTIMAL REGULATION OF PHYSIOLOGICAL SYSTEMS VIA REAL-TIME ADAPTIVE MODEL SYNTHESIS Information Systems Lab.**
Cristy M. Schade Aug. 1971 97 p refs
(Contract N00014-67-A-0112-0044)
(AD-735900; SU-SEL-71-033; SU-TR-6792-2) Avail: NTIS CSCL 06/2

Optimal control algorithms that use an adaptive non-recursive digital filter model for on-line closed-loop blood pressure regulation have been developed. This Automatic Therapeutic Control System was designed specifically for the regulation of physiological systems, but the design assumptions are such that it should prove very useful for a much broader class of control problems. An Adaptive Model Control system has been developed, the analysis of which is presented in two parts: (1) the real-time adaptive model synthesis procedure, and (2) the optimal forward-time controller. The adaptive modeling process is accomplished by the rapidly converging Alpha-LMS Algorithm. The conditions necessary to guarantee convergence for deterministic inputs are presented for zero mean and nonzero mean additive-output noise system and also for the low-order approximation problem. The optimal forward-time controller is described. The results of an experimental run are included in which these algorithms were used to regulate the blood pressure of a dog that had been artificially placed in a hypotensive state (shock). The results of this and similar experiments have been very successful from both an engineering and medical point of view, and if the necessary arrangements can be made with the local hospitals, this system will be used in the near future as part of an intensive care unit. Author (GRA)

**N72-21089#** Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
**PEDAL OPERATION BY THE SEATED OPERATOR**
K. H. Eberhard Kroemer Jan. 1972 13 p refs Presented at the Soc. of Automotive Eng. Congr., Detroit, 10-14 Jan. 1972
(AF Proj. 7184)
(AD-735315; AMRL-TR-71-102) Avail: NTIS CSCL 05/5

The paper attempts to serve three purposes: (1) To summarize the open scientific literature on muscular force applicable to pedals, and on the efficiency of foot motions on or between pedals depending on the body support and the body posture of the seated operator. (2) To discuss the applicability of such studies in automobile (or other equipment) design, especially to the design, selection, and arrangement of foot-operated controls. (3) To point out that for most conventional vehicles and equipment, modes of seating, and of a pedal arrangement and operation follow largely common experience and tradition, and only partly scientific findings. For new man-machine systems, new solutions seem possible. Author (GRA)

**N72-21090#** Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
**AUTOMATED INSTRUCTIONAL MONITORS FOR COMPLEX OPERATIONAL TASKS Final Report**
Wallace Feurzeig and George Lukas 31 Oct. 1971 43 p
(Contract N00014-69-C-0127; NR Proj. 154-285)
(AD-736212; BBN-2272) Avail: NTIS CSCL 05/9

The report describes research on computer-based instructional techniques incorporating diagnosis of student difficulties in acquiring complex concepts and skills. A computer automatically generates a simulated display. It then monitors and analyzes a student's work in the performance of assigned training tasks; hypotheses describing specific learning difficulties are tested and appropriate advice is given. Two major task areas were studied. Implications for the development of improved methods of behavior modification and their incoporation in training programs are discussed. Author (GRA)

# 06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

**N72-21091** National Lending Library for Science and Technology, Boston Spa (England).
**THE PREFERENTIAL POSITION OF TUNGSTEN CARBIDE IN THE CONSTITUTION OF CEMENTED CARBIDES**
F. Koelbl 28 Dec. 1972 14 p Transl. into ENGLISH from Planseeber. Pulvermet. (Austria), v. 19, 1971 p 18-24 In GERMAN and ENGLISH
(NLL-Trans-746-1099-(9022.401); LTI-737-13283) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The advantages of using tungsten carbides in the production of commercial cemented carbides are considered, including mechanical properties, solubility in liquid cobalt binder, and grain size. The function of other carbides in tungsten carbide based cemented carbides is also discussed. K.P.D.

**N72-21092** National Lending Library for Science and Technology, Boston Spa (England).
**PREPARATION OF NITRIDES BY PLASMA JETS Transl. into ENGLISH from Kinzoku (Japan), v. 38, no. 15, 1968 p 69-71**
Osamu Matsumoto Feb. 1972 11 p refs
(NLL-RTS-6884) Avail: Natl. Lending Library, Boston Spa Engl.: £1.00; 3 NLL photocopy coupons

The production of nitrides and the mechanisms involved in utilizing plasma jets is considered. The processes involved in the production of nitrides using plasma jets are considered. Chemical reactions, reaction rates, and the production of nitrides from metals and oxides are discussed. K.P.D.

**N72-21093** National Lending Library for Science and Technology, Boston Spa (England).
**THE SURFACE CHEMISTRY OF ADHESION**
T. Hata Feb. 1972 22 p refs Transl. into ENGLISH from Kogyo Kagaku Zasshi (Japan), v. 73, no. 1, 1970 p 10-15
(NLL-RTS-6925) Avail: Natl. Lending Library, Boston Spa, Engl.: £2.10; 7 NLL photocopy coupons

The definition of adhesion and various types of adhesives are discussed. Elementary processes of adhesion are considered. Moistening and adhesion, critical surface tension in a solid, and optimum conditions for adhesion are also treated. The thermodynamics of mixing, and the functions and limits of solubility parameters in adhesion are briefly reviewed. K.P.D.

**N72-21094*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**PHOTOETCHING OF METAL-OXIDE LAYERS Patent**
Hans B. Bullinger, inventor (to NASA) Issued 26 Oct. 1971 5 p Filed 13 Jun. 1969 Supersedes N69-31467 (07 - 17, p 3113)
(NASA-Case-ERC-10108; US-Patent-3,615,465; US-Patent-Appl-SN-833049; US-Patent-Class-96-36.2; US-Patent-Class-156-3) Avail: US Patent Office CSCL 07D

Techniques for the selective removal of conductive coatings from nonconductive base materials are described. Conventional photofabrication techniques expose precisely defined regions of a coating, typically a metal oxide, which are to be removed, followed by the application of a metallic element and water and an acid. After the metal oxide coating, the slurry of the metallic element and water, and the acid are brought in contact with each other, a reaction occurs whereby the metal oxide coating is reduced to elemental metal. The reaction is allowed to continue for a short time only whereby the elemental metal is but superficially attacked and is followed by an acid wash to remove the exposed elemental metal coating.

Official Gazette of the U.S. Patent Office

**N72-21095*#** Wisconsin Univ., Madison. Theoretical Chemistry Inst.

**EVALUATION OF JACOBIAN DETERMINANTS BY MONTE CARLO METHODS: APPLICATION TO THE QUASICLASSICAL APPROXIMATION IN MOLECULAR SCATTERING**

Robert A. LaBudde 29 Nov. 1971 12 p refs

(Grants NGL-50-002-001; NSF GP-26014)

(NASA-CR-125978; WIS-TCI-462) Avail: NTIS CSCL 07B

A technique is described which can be used to evaluate Jacobian determinants which occur in classical mechanical and quasiclassical approximation descriptions of molecular scattering. The method may be valuable in the study of reactive scattering using the quasiclassical approximation. Author

**N72-21096*#** Oak Ridge National Lab., Tenn.

**PROGRAM FOR COMPUTING PARTIAL PRESSURES FROM RESIDUAL GAS ANALYZER DATA**

D. S. Easton, Carla A. Giles, Sandra H. Merriman, and R. E. Clausing Sep. 1971 96 p refs

(Contract W-7405-eng-26; NASA-SNSO-C-40-24-63)

(NASA-CR-125938; ORNL-TM-3455) Avail: NTIS CSCL 07D

A computer program for determining the partial pressures of various gases from residual-gas-analyzer data is given. The analysis of the ion currents of 18 m/e spectrometer peaks allows the determination of 12 gases simultaneously. Comparison is made to ion-gage readings along with certain other control information. The output data are presented in both tabular and graphical form. Author

**N72-21097*#** Los Alamos Scientific Lab., N.Mex.

**CMB-13 RESEARCH ON CARBON AND GRAPHITE Progress Summary Report, 1 Aug. - 31 Oct. 1971**

Morton C. Smith Mar. 1972 13 p refs

(NASA Order W-12595; Contract W-7405-eng-36)

(NASA-CR-125937; Rept-19; LA-4917-PR) Avail: NTIS CSCL 07D

The effects of grinding on Santa Maria coke are considered, as well as the production of resin-bonded graphite from the coke. Kynol fibers, properties and purities of coal tar pitches, carbonization of resin components, synthesis of gamma BL (4-furfuryl 2-pentenoic acid gamma lactone), and a glass-like carbon powder for use as a filler are also discussed. The hydrogen contents of commercial cokes and graphites are tabulated, and a quantimet image-analyzing computer and its operation are described. K.P.D.

**N72-21098*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**REACTIVITY OF SIMULATED LUNAR MATERIAL WITH FLUORINE**

Patricia M. ODonnell Washington Apr. 1972 9 p refs

(NASA-TM-X-2533; E-6741) Avail: NTIS CSCL 07D

Simulated lunar surface material was caused to react with fluorine to determine the feasibility of producing oxygen by this method. The maximum total fluorine pressure used was 53.3 kilonewtons per square meter (400 torr) at temperatures up to 523 K (250 C). Postreaction analysis of both the gas and solid phases indicated that the reaction is feasible but that the efficiency is only about 4 percent of that predicted by theory.

Author

**N72-21099*#** General Dynamics Corp., San Diego, Calif.

**CATALYST CARTRIDGE FOR CARBON DIOXIDE REDUCTION UNIT Patent Application**

Roy F. Holmes, inventor (to NASA) Filed 21 Oct. 1971 16 p

(Contract NAS1-8217)

(NASA-Case-LAR-10551-1; US-Patent-Appl-SN-191301) Avail: NTIS CSCL 07D

A catalyst cartridge is described for use in a system for the reduction of carbon dioxide to water and carbon, utilizing the Bosch catalytic reaction. A mixture of hydrogen and carbon dioxide gases is compressed, heated to a reaction temperature of 1000 to 1400 F, and fed to the center of cylindrical catalyst cartridge in a reactor vessel. The mixture of carbon dioxide and hydrogen passes outwardly through the perforated inner wall of the catalyst cartridge and quartz wool batting, and carbon dioxide in the presence of hydrogen and the catalytic iron is reduced to solid carbon and water. Carbon in solid form is retained within the catalyst mesh. Water vapor, together with a mixture of hydrogen, methane, carbon monoxide, and unreacted carbon dioxide passes through the outer batting and perforations of the outer wall of the cartridge and is then condensed and separated from the other off-gases, which are in turn recycled after mixing together with added hydrogen and carbon dioxide.

NASA

**N72-21100*#** McDonnell-Douglas Co., St. Louis, Mo.

**UTILIZATION OF OXYGEN DIFLUORIDE FOR SYNTHESES OF FLUOROPOLYMERS Patent Application**

Madeline S. Toy, inventor (to NASA) Filed 11 Jun. 1970 35 p

(Contract NAS7-723)

(NASA-Case-NPO-12061-1; US-Patent-Appl-SN-45549) Avail: NTIS CSCL 07D

Oxygen difluoride, OF2, is reacted with ethylinically unsaturated fluorocarbon compounds. Depending upon the fluorocarbon material and reaction conditions, OF2 can chain-extend fluoropolyenes, convert functional perfluorovinyl groups to acyl fluoride and/or epoxide groups, and act as a monomer for an addition-type copolymerization with diolefins.

NASA

**N72-21101*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

**POLYMERIZABLE DISILANOLS HAVING IN-CHAIN PERFLUOROALKYL GROUPS Patent Application**

William J. Patterson and Donald E. Morris, inventors (to NASA) Filed 20 Jan. 1972 10 p

(NASA-Case-MFS-20979-2; US-Patent-Appl-SN-219590) Avail: NTIS CSCL 07C

A process for preparing disilanols with in-chain perfluoroalkyl groups is described, in which R is a monovalent hydrocarbon radical, Ar is an arylene group, and x in the group (CF2) sub x may vary between 2 and 8. The disilanols, when reacted with a diaminosilane and cured, produce polymeric material resistant to hydrocarbon fuels and stable at elevated temperatures. NASA

**N72-21102*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**POLYIMIDE FOAM FOR THERMAL INSULATION AND FIRE PROTECTION Patent Application**

Robert W. Rosser, inventor (to NASA) Filed 12 Nov. 1971 20 p

(NASA-Case-ARC-10464-1; US-Patent-Appl-SN-198472) Avail: NTIS CSCL 07D

In the preparation of polyimide foams by the reaction of polyisocyanates and polyfunctional aromatic acid derivatives, flame retardant foamed products of improved cell quality, friability, and resiliency are obtained by conducting the reaction in the presence of an alkanolamine, such as l-hydroxyethyl-2-heptadecenyl glyoxalidine. Another aspect of the invention

resides in the finding that polyimide foams of reproducible density above 1 lb/cu ft and below 6 lbs/cu ft can be obtained by employing in the reaction at least 2% by weight of siloxane-glycol copolymer as a surfactant which acts as a specific density control agent. A further feature of the invention is the production of polyimide foams into which reinforcing fibers such as silicon dioxide and carbon fibers may be incorporated.
NASA

N72-21103*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**METHOD OF DETECTING OXYGEN IN A GAS Patent Application**
Herbert D. Hendricks, inventor (to NASA) Filed 17 Aug. 1971 13 p
(NASA-Case-LAR-10668-1; US-Patent-Appl-SN-172459) Avail: NTIS CSCL 07D

The presence of oxygen in a gas is detected by placing an article, such as a film of poly(ethylenenaphthalene-dicarboxylate), in contact with a gas and simultaneously exposing the article to ultraviolet light. The article is subsequently heated and the presence of oxygen in the gas is indicated by thermoluminescence.
NASA

N72-21104# Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
**THERMAL REGENERATION OF THE TENSILE PROPERTIES OF HYDROLYTICALLY DEGRADED POLYIMIDE FILM**
R. Delasi Apr. 1972 24 p refs
(RM-538) Avail: NTIS

Heat treatment at temperatures of 224 to 310 C of hydrolytically degraded polyimide film was shown to regenerate ultimate tensile strength from 15.1 ksi to 24.3 ksi after 80 hours at 224 C and to 25.8 ksi after two hours at 310 C. Elongation to failure is simultaneously increased from 4.8 to 29.0 percent at 310 C. Prior to degradation, the film had an ultimate tensile strength of 26.6 ksi and an elongation to failure of 47.0 percent. The kinetics of this regeneration indicate that the reaction corresponds to the two-step recombination of the hydrolytically attacked amide linkages initially present in the polyimide film as received. The regenerated polyimide exhibits an improved hydrolytic stability over the untreated material and specimens heat treated directly without prior aqueous degradation. Author

N72-21105*# McDonnell-Douglas Co., St. Louis, Mo.
**THERMALLY CONDUCTIVE POLYMERS Patent Application**
Norman R. Byrd, Robert K. Jenkins, and James L. Lister, inventors (to NASA) Filed 27 Apr. 1971 12 p
(Contract NAS5-10260)
(NASA-Case-GSC-11304-1; US-Patent-Appl-SN-137912) Avail: NTIS CSCL 07D

A thermally conductive polymer is provided having physical and chemical properties suited to use as a medium for potting electrical components. The polymer is prepared from hydroquinone, phenol, and formaldehyde, by conventional procedures employed for the preparation of phenol-formaldehyde resins. While the proportions of the monomers can be varied, a preferred polymer is formed from the monomers in a 1:1:2.4 molar or ratio of hydroquinone:phenol:formaldehyde.
NASA

N72-21106# Brookhaven National Lab., Upton, N.Y.
**MAGNETIC ORDERING IN A LINEAR CHAIN COMPOUND RbFeCl3**
G. R. Davidson (Bell Telephone Labs., Inc., Murray Hill, N. J.), M. Eibschuetz (Bell Telephone Labs., Inc., Murray Hill, N. J.), D. E. Cox, and V. J. Minkiewicz [1971] 5 p refs Presented at 17th Ann. Conf. on Magnetism and Magnetic Mater., Chicago, 16-19 Nov. 1971 Prepared in cooperation with Bell Telephone Labs., Inc., Murray Hill, N. J.
(BNL-16327; Conf-711108-7) Avail: NTIS

Results of neutron diffraction and Mossbauer effect studies of the hexagonal linear chain compound RbFeC13 are reported for the temperature range from 1.2 K to room temperature. Three-dimensional magnetic ordering was found to occur at T sub N = 2.55 + or - 0.05 K. Single crystal neutron scattering results above T sub N are indicative of one-dimensional ferromagnetic correlations along the c-axis chains. Below T sub N the magnetic moments mu are coupled ferromagnetically along the chains but lie in the basal plane, where they form an antiferromagnetic array. The hyperfine magnetic field H sub in also lies in the basal plane and is nearly proportional in magnitude to mu. The temperature dependence of H sub in and mu indicates a 0 K saturation value for mu of about 2 mu beta.
Author

N72-21107# Brookhaven National Lab., Upton, N.Y.
**MAGNETIC STRUCTURE AND MOSSBAUER STUDIES OF THE LAYER ANTIFERROMAGNETS ALPHA-RbFeF4 AND KFeF4**
M. Eibschuetz (Bell Telephone Labs., Inc., Murray Hill, N. J.), G. R. Davidson (Bell Telephone Labs., Inc., Murray Hill, N. J.), H. J. Guggenheim (Bell Telephone Labs., Inc., Murray Hill, N. J.), and D. E. Cox [1971] 10 p refs Presented at 17th Ann. Conf. on Magnetism and Magnetic Mater., Chicago, 16-19 Nov. 1971 Prepared in cooperation with Bell Telephone Labs., Inc., Murray Hill, N. J.
(BNL-16326; Conf-711108-6) Avail: NTIS

Powder neutron data for alpha RbFeF4 reveal that there is antiferromagnetic coupling between nearest neighbors within layers and between those in adjacent layers. Single crystal neutron data show that above T sub N the magnetic scattering is in the form of reciprocal lattice rods characteristic of long range two-dimensional correlations. Mossbauer effect measurements in the antiferromagnetic state of KFeF4 yield well resolved hyperfine spectra, revealing a magnetic field and EFG tensor at all iron nuclei. The temperature variation of the sublattice magnetization in KFeF4 was determined by measuring the internal field at the iron site. At low temperature (T < T sub N/2), the results agree with simple two-dimensional spin wave theory. For 0/72 < T/T sub N<0.99, the internal field follows a (( T sub N) - T) to the beta-th power law with beta = 0.185 + or - 0.005 and T sub N = 137.2 + or - 0.1 K.
Author

N72-21108# Oak Ridge National Lab., Tenn.
**EFFECT OF OXYGEN IN STATIC SODIUM ON VANADIUM AND VANADIUM ALLOYS**
R. L. Klueh and J. H. DeVan Nov. 1971 36 p refs
(Contract W-7405-eng-26)
(ORNL-4739) Avail: NTIS

When unalloyed vanadium in a vanadium capsule was exposed at 600 and 800 C to sodium that contained up to 1500 ppM O, the specimen and capsule gettered all the oxygen. Vanadium specimens were also exposed to sodium containing up to 4000 ppM O at 600 C in capsules of type 304L stainless steel and molybdenum. Except when the sodium contained over 2000 ppM O, all oxygen was gettered. It was concluded that the oxygen distribution coefficient between vanadium and sodium, that is, the ratio of the oxygen concentration in the vanadium to that in the sodium, at equilibrium, is greater than 10,000. To compare the effects of oxygen in sodium on various vanadium alloys with that on unalloyed vanadium, specimens of the alloys and unalloyed vanadium were simultaneously exposed to sodium containing 2000 ppM O.
Author (NSA)

N72-21109# Mound Lab., Miamisburg, Ohio.
**STABLE GASEOUS ISOTOPE SEPARATION AND PURIFICATION, APRIL - JUNE 1971**
7 Oct. 1971 44 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1828) Avail: NTIS

Results of research on carbon isotope separation are presented. Separation methods such as CO distillation, chemical exchange, liquid thermal diffusion, and gaseous thermal diffusion were studied. Efforts devoted to stable gaseous isotope separation are summarized. Work on separation of isotopes of Ar, He, Ne,

Kr, and Xe is report. Thermal diffusion research is reported for molecular beam scattering, transport properties, isotopic thermal diffusion factors for Kr, and mutual diffusion coefficients. Low temperature research is reported for He-3 distillation, superfluid film phase transition in He mixtures, and vapor pressure ratio in mixed Ne-20 and Ne-22. NSA

N72-21110# Mound Lab., Miamisburg, Ohio.
**STABLE GASEOUS ISOTOPE SEPARATION AND PURIFICATION, JULY - SEPTEMBER 1971**
15 Oct. 1971 24 p refs
(Contract AT(33-1)-GEN-5)
(MLM-1861) Avail: NTIS

Results of research are presented on carbon isotope separation by CO distillation, chemical exhange, liquid thermal diffusion, gaseous thermal diffusion, and carbonate conversion. Work on separation of gaseous isotopes of Ar, He, Kr, Ne, and Xe is summarized. Other work is reported on diffusion in H-He and H-He-4 systems. Research on low temperature He-3 distillation is also reported. NSA

N72-21111# Interuniversitair Reactor Instituut, Delft (Netherlands).
**DETERMINATION OF MERCURY IN SAMPLES FROM THE DUTCH ENVIRONMENT**
J. J. M. de Goeij [1971] 23 p refs Presented at the Am. Nucl. Soc. Topical Meeting on Nucl. Methods in Environ. Res., Columbia, Mo. Prepared jointly with Utrecht State Univ. and the Inst. of Soil Fertility
(IRI-133-71-17) Avail: NTIS

The mercury pollution in the dutch environment was determined by neutron activation analysis of environmental samples. An additional chemical separation method was required for samples in which low background activity was induced. A chemical method is described which decomposes, oxidizes, and distills the irradiated sample. Experimental results determining the mercury level in birds of prey, Rhine sediments, marine organisms, canned fishes etc., are reported. ESRO

N72-21112# Harry Diamond Labs., Washington, D.C.
**FREE-ION ENERY LEVELS OF TRIPLY IONIZED THULIUM INCLUDING THE SPIN-SPIN, ORBIT-ORBIT, AND SPIN-OTHER-ORBIT INTERACTIONS**
C. A. Morrison and D. E. Wortman Nov. 1971 29 p refs
(AD-735319; HDL-TR-1563) Avail: NTIS CSCL 07/4

The energy levels of triply ionized thulium have been calculated for a number of reported parameters characterizing the spin-orbit and Coulomb interaction using total angular momentum states of the 4f12 configuration. For typical values of these parameters, it is shown that severe term mixing occurs. The effects of the spin-spin, orbit-orbit, and spin-other-orbit interactions on the free ion levels are also investigated. It is further shown that the inclusion of all three latter interactions, with the exception of the contact term of the spin-spin interaction, adds only three parameters to the Coulomb and spin-orbit parameters. Author (GRA)

N72-21113# TRW Systems Group, Redondo Beach, Calif.
**STUDIES OF THE FORMATION AND DECAY OF TRIPLET STATES OF AROMATIC MOLECULES Final Report, Mar. 1967 - Dec. 1971**
Maurice W. Windsor 23 Dec. 1971 55 p refs
(Contract N00014-67-C-0327)
(AD-735483; TRW-07126-6010-R000) Avail: NTIS CSCL 07/4

Experimental techniques for measuring fluorescence, phosphorescence and triplet quantum yields for organic molecules in rigid plastic media as a function of temperature were developed. Comprehensive sets of data were obtained for pyrene, coronene, 1,2-benzocoronene and 1,12-benzoperylene. The fluorescence yields of 18 aromatics were observed in absorption using the new technique of nanosecond laser photolysis and spectroscopy. The effects of H-banding were studied in several azo-aromatics. The data obtained were used to draw conclusions relevant to the theory of radiationless transitions. Finally an experimental technique for pico-second laser photolysis and spectroscopy was developed and used to observe inverse Raman spectra of several molecules and a new subnanosecond transient absorption in the dye laser molecule, Rhodamine-6G. Author (GRA)

N72-21114# California Univ., Berkeley. Div. of Applied Mechanics.
**A CLASS OF NON-ISOTHERMAL VISCOELASTIC FLUIDS**
M. J. Crochet and P. M. Naghdi Dec. 1971 59 p refs
(Contract N00014-69-A-0200-1008; NR Proj. 064-436)
(AD-735928; AM-71-6) Avail: NTIS CSCL 07/4

The paper is concerned mainly with non-isothermal constitutive equations and related thermodynamical results for a class of simple fluids with fading memory. The development is partly motivated by a 'flow-like' behavior of some organic polymers at a sufficiently high temperature and can also be regarded as the counterpart of (and supplementary to) an earlier study of a class of viscoelastic solids. Special cases of our general results pertaining to a finite linear theory and an incompressible viscoelastic fluid, as well as the relationship of the stress constitutive equation in the latter case with the corresponding result for materials of differential type, are discussed. Author (GRA)

N72-21115# General Electric Co., Santa Barbara, Calif. DASA Information and Analysis Center.
**NEWSLETTER NO. 28. REACTION RATE SERIES**
Jul. 1971 27 p refs
(Contract DASA01-70-C-0035)
(AD-735510) Avail: NTIS CSCL 07/4

The issue of the DASIAC Reaction Rate Data presents summaries of recent progress reports and other informal information of current interest in the reaction rate field. GRA

N72-21116# California Univ., Santa Barbara. Dept. of Chemistry.
**ABSORPTION AND LUMINESCENCE OF AROMATIC MOLECULES AT HIGH PRESSURES**
Henry W. Offew Nov. 1971 82 p refs
(Contract N00014-69-A-0200-8010; NR Proj. 056-514)
(AD-735163; TR-4) Avail: NTIS CSCL 07/4

The effects of high pressure on the spectroscopic properties of aromatic hydrocarbons are reviewed. The topics are: aromatic molecules in inert matrices, the spectral shift in the absorption, fluorescence and phosphorescence spectra, band broadening, intensities and lifetimes. Specific Interactions between aromatic molecules at high pressures are also included: absorption and fluorescence of electron-donor-acceptor complexes, excited state reactions in solution, excimers in polymers, absorption, fluorescence and delayed fluorescence of aromatic crystals. The report summarizes the application of high pressure spectroscopic techniques to one class of organic materials in the last five years. Author (GRA)

N72-21524# Joint Publications Research Service, Arlington, Va.
**NEUTRON DIFFRACTION ANALYSIS OF NIOBIUM NITRIDE Nb4N3**
A. Yu. Chervyakov, V. A. Somenkov, Ya. S. Umanskiy, S. Sh. Shil'shteyn, and V. P. Yanchur *In its* Nonferrous Met. 9 Mar. 1972 p 36-40 refs (See N72-21517 12-17)
Avail: NTIS

# 07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

**N72-21117*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**RADAR CALIBRATION SPHERE Patent**
Robert T. Holdren, III, inventor (to NASA) Issued 23 Nov. 1971 7 p Filed 30 Mar. 1970 Supersedes N70-35858 (08 - 19, p 3500)
(NASA-Case-XLA-11154; US-Patent-3,623,107; US-Patent-Appl-SN-23532; US-Patent-Class-343-706; US-Patent-Class-343-912) Avail: US Patent Office CSCL 17I

A firm, lightweight, conductive-coated, plastic sphere is described. It is adapted for launching by a gas-filled balloon or similar apparatus for radar tracking and calibration.
Official Gazette of the U.S. Patent Office

**N72-21118*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**METHOD AND APPARATUS FOR MAPPING PLANETS patent**
Richard L. Horttor and Richard M. Goldstein, inventors (to NASA) 30 Nov. 1971 9 p Filed 9 Sep. 1969 Supersedes N70-12617 (08-02, p 0245) Sponsored by NASA
(NASA-Case-NPO-11001; US-Patent-3,624,650; US-Patent-Appl-SN-856279; US-Patent-Class-343-6.5R; US-Patent-Class-343-5CM; US-Patent-Class-343-100ST) Avail: US Patent Office CSCL 17I

A radar system is described for obtaining data to map planets by use of an onboard S-band ranging transponder and a stationary transmitter-receiver station on earth. A radar signal is transmitted from the ground station to the spacecraft, routed through the transponder, and retransmitted on a different carrier frequency. The retransmitted signal is reflected by the planet being mapped to the earthbound station. For range resolution, the radar signal is modulated by a pseudonoise code word. The signal received by the ground station is stored for later analysis consisting of range gating the recorded signal. Real time is synchronously recorded with the signal received for proper tracking of the round trip delay and to establish slant range contours of particular mapping points. Resolution of the Doppler contours is acomplished by a filter which matches the motion-induced phase shift on the signal received and recorded.
D.L.G.

**N72-21119*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**RECORDER USING SELECTIVE NOISE FILTER Patent**
John E. Mulhern, Jr. and Dwight M. Harris, inventors (to NASA) Issued 19 Oct. 1971 6 p Filed 5 Feb. 1969
(NASA-Case-ERC-10112; US-Patent-3,614,343; US-Patent-Appl-SN-796690; US-Patent-Class-179-100.2K) Avail: US Patent Office CSCL 14C

A recording method and system is described which provides for selective reprocessing and filtering of the data to obtain the optimum signal-to-noise ratio without a corresponding loss of the data range or fidelity. More particularly, an improved method and system for producing a multidimensional recording of a multivariable data signal with a minimum amount of low-frequency noise and interference in the signal is presented.
Official Gazette of the U.S. Patent Office

**N72-21120*#** Newcastle Univ. (Australia).
**OPTIMAL FILTER DESIGN SUBJECT TO OUTPUT DELOBE CONSTRAINTS**
Thomas E. Fortmann and Michael Athans (MIT., Cambridge) Feb. 1972 45 p refs Sponsored in part by Australian Res. Grants Comm.
(Grants NGL-22-009-124; NSF GK-2645) (NASA-CR-125935; ESL-P-473) Avail: NTIS CSCL 17I

The design of filters for detection and estimation in radar and communications systems is considered, with inequality constraints on the maximum output sidelobe levels. A constrained optimization problem in Hilbert space is formulated, incorporating the sidelobe constraints via a partial ordering of continuous functions. Generalized versions (in Hilbert space) of the Kuhn-Tucker and Duality Theorems allow the reduction of this problem to an unconstrained one in the dual space of regular Borel measures. A convergent algorithm is presented for computational solution of the dual problem. Author

**N72-21121#** Advisory Group for Aerospace Research and Development, Paris (France).
**RADAR PROPAGATION IN THE ARCTIC**
Jon Frihagen, ed. Jan. 1972 430 p refs Presented at Specialists Meeting of the Electromagnetic Wave Propagation Panel of AGARD, Lindau/Harz, West Germany, 13-17 Sep. 1971
(AGARD-CP-97) Avail: NTIS HC $6.00/MF $0.95

The characteristics and effects of the Arctic ionosphere on radio and radar propagation are considered. Experimental and theoretical efforts in the field are reviewed. For individual titles, see N72-21122 through N72-21153.

**N72-21122#** Communications Research Centre, Ottawa (Ontario).
**MORPHOLOGY OF RADIO-RADAR POLAR PROPAGATION EFFECTS**
T. R. Hartz *In* AGARD Radar Propagation in the Arctic Jan. 1972 18 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

A variety of observational data are reviewed for the polar upper atmosphere, and particularly for morphological patterns deduced for particle precipitation associated with auroral phenomena and with polar cap disturbances. The significance of different portions of such patterns are discussed with reference to particle energies, sources, and ionospheric changes during disturbed intervals. Statistical data are given on the diurnal, seasonal, and spatial variation of such associated propagation effects as absorption, scintillation, dispersion etc., along with their correlation with magnetic activity, spread F, sporadic E, visual aurora, and radio noise observations. In addition, the storm time variation of some of these phenomena are discussed from the point of view of their short term effects on radio wave propagation. Author

**N72-21123#** Air Force Cambridge Research Labs., L. G. Hanson Field, Mass.
**ON MODELLING THE ARCTIC IONOSPHERE** c13
G. J. Gassman *In* AGARD Radar Propagation in the Arctic Jan. 1972 8 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

It appears that the prediction of the Arctic ionosphere in the manner and with the accuracy accomplished for moderate latitudes is not yet possible. However, from already established general patterns, it seems feasible to provide an hourly updated and fairly accurate description by real time processing of data from a few observing stations. A number of suitable observing techniques are discussed. Author

**N72-21124#** Imperial Coll. of Science and Technology, London (England). Physics Dept.
**THE POLAR EXOSPHERIC PLASMA** c29
J. O. Thomas and A. D. R. Phelps *In* AGARD Radar Propagation in the Arctic Jan. 1972 11 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

The main features of the spatial distribution of plasma in

the earth's polar exosphere deduced from satellite observations are described and related to recent measurements of incoming particles of magnetospheric origin, particularly in the low energy range (about 1000 eV). The topics include: (1) the termination of the terrestrial plasmasphere; (2) the identification and location of a ring or torus of enhanced plasma density surrounding each pole stationary with respect to the sun, and under which the earth rotates; (3) the geomagnetic control of ionization, with the recognition of effects occurring at certain universal times associated with the geometry of the geomagnetic axis earth-sun line system; and (4) the polar wind. Some of the main physical processes contributing to both static as well as dynamic features of the overall structure of the polar plasma distribution are introduced. Author

**N72-21125#** Air Force Cambridge Research Labs., L. G. Hanson Field, Mass.
**A DISCUSSION OF ARCTIC IONOGRAMS** c13
R. A. Wagner and C. P. Pike *In* AGARD Radar Propagation in the Arctic Jan. 1972 20 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

Examples of Arctic ionogram sequences, recorded on the AFCRL flying ionospheric laboratory, are presented. It is shown that: (1) Ionogram sequences facilitate the interpretation of oblique incidence echoes from E and F layer heights. (2) Parameters of the Arctic ionosphere can be mapped by using the auroral oval as an ordering system. (3) Vertical and oblique incidence echoes appearing on ground station ionograms can be interpreted in terms of the station's position relative to the auroral oval. The analysis of a three-hour flight with six latitudinal scans underneath an auroral band shows the close relationship between auroral-type sporadic E echoes and discrete auroras. The investigation of 49 latitudinal scans through the auroral oval during times of low magnetic activity revealed the existence of a particle-produced E layer which is oval-aligned, is 2 to 6 deg wide in corrected geomagnetic latitude, and occurs at all corrected geomagnetic times. This layer produces the night E layer. An ionogram analysis procedure which uses oblique incidence F layer echoes is demonstrated, and the feasibility is suggested of monitoring the latitude of the southern edge of the polar F layer irregularity zone by using this technique. Author

**N72-21126#** Stanford Research Inst., Menlo Park, Calif.
**POLAR PROPAGATION EFFECTS ON VHF-UHF RADARS**
Walter G. Chestnut *In* AGARD Radar Propagation in the Arctic Jan. 1972 38 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

The effects upon VHF-UHF radar which are considered are wave distortions caused by wave interaction with E and F region auroral ionization, including auroral backscatter (auroral clutter) and forward scatter that leads to amplitude and angle scintillation. Recent results of pulse-radar-backscatter studies from aurora are reviewed and theories of irregularity production are considered. Aurorally produced radar tracking and amplitude scintillation are discussed. Some results from aurorally disturbed monopulse tracking of satellites are presented. Author

**N72-21127#** National Research Council of Canada, Ottawa (Ontario). Astrophysics Branch.
**OBSERVATIONS OF 48 MHz AURORAL RADAR PROPAGATION ON A NETWORK IN THE AURORAL ZONE** c13
A. G. McNamara *In* AGARD Radar Propagations in the Arctic Jan. 1972 8 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

Four auroral radars are operated on a continuous basis at Ottawa, Thompson, Churchill, and Great Whale in Canada. The Ottawa radar is at 40 deg latitude and the other three are at approximately 57 deg, in the auroral zone. The high incidence of auroral activity at these locations permits both statistical and detailed single event studies of radio aurora morphology and scattering mechanisms. In spite of magnetic aspect control, strong auroral backscatter signals are detected at all azimuths with aspect angles of up to 25 deg from the magnetic perpendicular. These observations create difficulties in explaining radar aurora in terms of ion acoustic waves developed from linear models such as the two-stream instability theory. As well as direct auroral backscatter, the radars sometimes detect sporadic E propagated ground scatter, usually in association with auroral disturbance. the simultaneous observations of these auroral phenomena by the multiple stations permit more definitive measurements of the processes involved. Author

**N72-21128#** Max-Planck-Institut fuer Aeronomie, Lindau Uber Northeim (West Germany).
**CURRENT EXPERIMENTAL RESULTS FROM A VHF-CW AURORAL BACKSCATTER NETWORK IN SCANDINAVIA** c13
G. Lange-Hesse *In* AGARD Radar Propagation in the Arctic Jan. 1972 16 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

VHF bistatic, continuous wave auroral backscatter communications (radio aurora) carried out since autumn 1967 on a network in Scandinavia and northern Germany were analyzed with respect to the influence of daytime, seasonal, and geomagnetic latitude on frequency occurrence. Examples are presented which show the close control of the VHF auroral backscatter by the polar electrojet. Examples are given for the correlation between optical and radio aurora. Author

**N72-21129#** Stanford Research Inst., Menlo Park, Calif.
**AURORAL RADAR BACKSCATTER STUDIES FROM HOMER, ALASKA**
W. G. Chestnut, J. C. Hodges, and R. L. Leadabrand *In* AGARD Radar Propagation in the Arctic Jan. 1972 11 p refs Sponsored in part by DASA, NSF, and RADC (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

Radar aurora were studied using a backscatter radar at six frequencies from 50 MHz to 3000 MHz. It was found that the frequency dependence of the volume scattering cross section of the auroral echoes is nearly exponential with frequency. The slope of this frequency dependence was found to vary with time but averaged 33 db per 1000 MHz. The magnetic aspect sensitivity was found to be nearly independent of frequency; the scattering cross section decreased by about 10 db per degree of aspect angle. Auroral radar echoes at a frequency of 139 MHz were compared with the location of particle precipitation as measured during fourteen passes of the OV1-18 satellite. It is found that, except for periods of very active aurora, nighttime radar aurora was never collocated with peaks in proton energy flux. Where a radar aurora was located, measured particle precipitation fluxes were adequate to produce equilibrium E region electron densities greater than 70,000 el/cc. Thus E region electron densities necessary for radar auroras seem to be produced by precipitating particles. Author

**N72-21130#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**SOME PROPERTIES OF RADAR AURORAL ECHOES AS OBSERVED AT A FREQUENCY OF 1295 MHz**
T. Hagfors *In* AGARD Radar Propagation in the Arctic Jan. 1972 16 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

Observations are described of radar auroras made at a frequency of 1295 MHz from Millstone Hill, Massachusetts. From maps of power returned versus azimuth, elevation angle, and range of specific events of diffuse aurora, it was found that a mean height of auroral echoes is close to 110 km, that the half power thickness is 7 km, and that the power scattered drops 3 db when the aspect angle with respect to the magnetic field is increased from zero to 0.4 deg. Spectral analysis of echoes returned from a volume of 10 x 10 x 10 cu km with a resolution of 600 Hz reveals a great variety of spectra, many of which are narrow and displaced as if from an ion-acoustic density instability. Other spectra are wide and contain contributions from approaching and receding waves simultaneously. The wide

spectra apparently are associated with regions where the radar beam is normal to the electrojet current. Simultaneous observations of auroral echoes and particle precipitation show that radio auroras may be observed without any measurable electron precipitation. Author

**N72-21131*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**MICROSTRUCTURE OF RADIO AURORA SCATTERING REGIONS**
A. Egeland (Oslo Univ., Norway), J. Holtet (Oslo Univ., Norway), and N. C. Maynard *In* AGARD Radar Propagation in the Arctic Jan. 1972 11 p refs (See N72-21121 12-07)
(NASA-TM-X-68302) Avail: NTIS CSCL 20N

Summaries are presented for studies of radio scattering from auroral ionization. Analyses were made of auroral returns from scaled, pencil beam radio systems. A brief discussion of scattering theories is given. Measurements of small scale fields, particle precipitation, and auroras are described. The microstructure and dynamics of auroras are also considered. Author

**N72-21132#** Western Ontario Univ., London. Centre for Radio Science.
**ION-ACOUSTIC WAVES IN AURORA** c13
P. A. Forsyth and G. F. Lyon *In* AGARD Radar Propagation in the Arctic Jan. 1972 5 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

Evidence is presented that ion-acoustic waves exist in the auroral plasma and that these waves contribute to the scattering of radio waves at both VHF and UHF frequencies. Recent results suggest that this kind of clutter will be observed even at latitudes where the line-of-sight may not be perpendicular to the magnetic field lines. It is also suggested that ion-acoustic waves may contribute to the angular scintillations observed at high latitudes for transionospheric propagation paths using UHF radio waves. Author

**N72-21133#** Saskatchewan Univ., Saskatoon. Inst. of Atmospheric Studies.
**POLARIZATION OF WAVES SCATTERED FROM AURORA**
A. Kavadas *In* AGARD Radar Propagation in the Arctic Jan. 1972 13 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

Various interactions which lead to depolarization and cross-polarization are examined and correlated to particular types of aurora and properties of the scattering medium. Experimental results obtained from complete polarization measurements are used to demonstrate the nature of these interactions and the resulting changes in the polarization of the propagating wave. The experimental results were obtained with a time-sharing polarimeter which recorded six orthogonal components of aurorally backscattered waves at 42 MHz. Waves scattered in the forward direction were studied with partial polarization measurements (two orthogonal components) of radio star scintillations. The polarization of the received wave correlates with magnetic activity. Author

**N72-21134#** Royal Radar Establishment, Malvern (England).
**NONSPECULAR IONOSPHERIC CLUTTER IN THE VHF AND UHF BANDS**
G. N. Taylor *In* AGARD Radar Propagation in the Arctic Jan. 1972 9 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

The intensity of weak scattering from electron density irregularities in the high latitude ionosphere, in directions not perpendicular to the magnetic field is considered. Signals may cause clutter in sensitive radar systems at wavelengths between 10m and 0.1m. The literature is surveyed, to obtain typical and worst case values of the rms density deviation and scale size of the irregularities, and to select appropriate spatial autocorrelation functions. Assuming an isotropic distribution, scattering cross sections are calculated. It is concluded that nonspecular clutter is not likely to be more intense than the background incoherent (Thomson) scatter signals at wavelengths less than about 4m, unless the acf becomes markedly non-Gaussian. The spatial variability and spectral characteristics of incoherent and nonspecular clutter signals are discussed briefly. Author

**N72-21135#** Battelle Memorial Inst., Columbus, Ohio.
**A PROGRAM FOR THE INVESTIGATION AND SIMULATION OF AURORAL INSTABILITY MECHANISMS**
J. T. Coleman *In* AGARD Radar Propagation in the Arctic Jan. 1972 11 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

A program is described for the simulation and analytical investigation of the scattering mechanisms of the radio aurora. The program is divided into two parts: the first is a simulation, on a scaled basis, of the important plasma mechanisms of the E region and its scattering conditions, and the second is a computation of the theoretical coherent interaction instability cross sections. Experimental evidence is presented for sensitivity of the coherent cross section to the drift current level, the local electron temperature, the local magnetic field intensity, gradients, and other parameters. The theoretical model estimates the differential radar cross section (in the hydrodynamic approximation) and includes the effects of relative drift between ions and electrons, and the gradient in electron density. In its present form, the model includes forward scatter, backscatter, and general bistatic scatter. The computation includes the frequency spectrum introduced by interaction with wave instabilities. Author

**N72-21136#** Raytheon Co., Sudbury, Mass.
**PHASE COHERENT HF RADAR OBSERVATIONS OF BARIUM RELEASES IN THE ARCTIC IONOSPHERE**
G. D. Thome *In* AGARD Radar Propagation in the Arctic Jan. 1972 6 p ref (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

Radar observations are reported which show that the development of optical striations is accompanied by an abrupt broadening of the Doppler spectrum, leading to returns with Doppler widths comparable to those observed from the natural radio aurora. In contrast to the natural ionosphere, the barium plasma is generated at a known instant of time and is confined to a limited volume of space. This makes it possible to study the evolution of irregularities in this plasma as a function of time and to study their radar aspect sensitivity without using narrow beam antennas. Prior to optical striation development, the barium cloud behaves as a smooth overdense target, exhibiting a discrete Doppler spectrum and producing regular Faraday fading. After the development of striations, the Doppler spectrum becomes diffuse and Faraday fading is lost. Author

**N72-21137#** Kiruna Geophysical Observatory (Sweden).
**POLAR PROPAGATION EFFECTS ON RADIO-ASTRONOMICAL AND SATELLITE TRANSMISSIONS**
Ludwik Liszka *In* AGARD Radar Propagation in the Arctic Jan. 1972 8 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

High latitude studies of scintillation phenomenon in radio signals from radio astronomy sources and satellites are reviewed. Morphology of high latitude scintillation is discussed, including geographic distribution, diurnal variations, and relation to magnetic activity. Studies of statistical properties of the signal received on the ground were found to be a useful source of information about the nature of irregularities in the ionosphere. Studies are reviewed with emphasis on parameters of the scintillation-producing layer. Finally, results of height determinations using the space receiver method and satellite transmissions are briefly discussed. Author

**N72-21138#** Air Force Cambridge Research Labs., L. G. Hanson Field, Mass.
**SATELLITE SCINTILLATIONS IN THE HIGH LATITUDE**

## F-LAYER IRREGULARITY REGION

Jules Aarons *In* AGARD Radar Propagation in the Arctic Jan. 1972 8 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

Polar observations from Spitzbergen show a trough or decrease in scintillation index, on the night side between an oval and a polar region. Using radio star data at 113 and 228 MHz, scintillation index increases of 0.50 to 7 were noted with increases in K index (propagation path intersection through the F layer (350 km) at 67 deg). Recordings of 136 MHz satellite signals from Narssarssuaq, Greenland also show that mean scintillation index increases during magnetic storms within the irregularity region. Thule observations of 40 MHz transmissions indicate the overhead pattern at invariant latitudes near 86 deg. A model is presented of a core of high electron density irregularities, probably centered above the auroral oval, but with a high occurrence of irregularities over the polar cap. In addition, the irregularity region at lower intensity extends below the oval at night. Author

**N72-21139#** Western Ontario Univ., London. Centre for Radio Science.

## ANGULAR DEVIATION OF RADIO WAVES

G. F. Lyon and P. A. Forsyth *In* AGARD Radar Propagation in the Arctic Jan. 1972 5 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

Angular deviations due to typical departures from horizontal stratification are modelled. In particular, the steep gradients and troughs in electron density typical of the polar ionosphere are considered. The results suggest that systems which depend upon precise measurements of angle of arrival for radio waves in the frequency range at least to the upper end of the VHF range may be subject to significant unavoidable error. Author

**N72-21140#** Norwegian Defence Research Establishment, Kjeller.

## HIGH LATITUDE SATELLITE SCINTILLATION

J. Frihagen and O. Bratteng (Auroral Obs., Tromsoe, Norway) *In* AGARD Radar Propagation in the Arctic Jan. 1972 8 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

Numerous measurements of the height of ionospheric irregularities giving rise to satellite scintillation have shown them to be located in the region 300-600 km above the ground. Observations show that there is no appreciable reduction in scintillation at 136 MHz when a satellite loses height from in excess of 1000 km to less than 300 km. When observed from Tromso (70 deg N) the mean scintillation depth at 136 MHz increases from south to north, increases with K, shows nighttime maxima and daytime minima. Some results of electron density from rockets launched from Andenes (69 deg N, 16 deg E) show strong irregularities, the electron density varying by up to 25% over a few tens of meters north of auroral forms. Over the auroral forms, the electron density varies smoothly. Author

**N72-21141#** Max-Planck-Institut fuer Aeronomie, Lindau Uber Northeim (West Germany).

## SATELLITE SCINTILLATION BETWEEN 43 DEG AND 66 DEG NORTHERN LATITUDE FROM 1964 TO 1969

Gerd K. Hartmann *In* AGARD Radar Propagation in the Arctic Jan. 1972 12 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

Since November 1964 till May 1969 the radio signals from the beacon satellite Explorer 22 were continuously recorded at Lindau, for obtaining the ionospheric electron content from Faraday-effect- and dispersive-Doppler-effect measurements. The obtained amplitude and phase recordings were compared. When the root mean square phase deviation, during distortions, e.g. phase scintillation, was equal or greater 1 radian, fast amplitude scintillations that exceeded 6 dB amplitude variations were found. The narrow scintillation belt, which was observed between 50 deg and 60 deg northern geographic latitude consists of two independent sub-belts. It is suggested that the scintillation activity increases by a factor of 2 for weak scintillations and by a factor of 4 strong scintillations, when Kp exceeds 3c. A southward motion with increasing magnetic activity was observed. In summer the SOFM seems to be approximately 2 deg further north than in winter. Author

**N72-21142#** Max-Planck-Institut fuer Aeronomie, Lindau Uber Northeim (West Germany).

## POLAR PROPAGATION EFFECTS ON HF RADARS

H. G. Moeller *In* AGARD Radar Propagation in the Arctic Jan. 1972 15 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

The CW and pulse transmission experiments in the auroral and subauroral region are reviewed. The phenomena that affect propagation are: dispersion of F2 critical frequency and hence horizontal electron density gradients, field-aligned irregularities in the F2 and E region, auroral Es, and D region absorption. The variation of these phenomena in time and space and the correlation with magnetic activity are discussed. Following propagation, effects were observed due to these phenomena: Transmission paths transversing horizontal gradients of electron density become asymmetric which has to be taken into account in MUF calculations. Strong curtains of irregularities cause non-great-circle transmission. The NGR transmission may be advantageous if it results in a MUF enhancement, or in bypassing an area of enhanced absorption, it is disadvantageous as time delay of the received signals is increased. The enhancement is often observed by auroral Es. Author

**N72-21143#** Stanford Research Inst., Menlo Park, Calif.

## FREQUENCY DISTORTION IN AURORAL HF PROPAGATION

J. B. Lomax *In* AGARD Radar Propagation in the Arctic Jan. 1972 12 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

The HF propagation in auroral regions results in greater frequency distortion of signals than that encountered at mid-latitudes. Observational data on the characteristics of this distortion as taken on a transauroral path between Palo Alto, California and Thule, Greenland are presented. Details of the frequency distortion are given in terms of measured power spectral densities, Doppler shifts, and the corresponding phase fluctuations. These quantities are in turn related to the temporal correlation function of the channel. Author

**N72-21144#** Rome Air Development Center, Griffiss AFB, N.Y.

## HIGH ALTITUDE HS SIGNAL TRANMISSION CHARACTERISTICS

R. A. Mather, B. L. Holtzclaw (GE Co., Syracuse, N. Y.), and R. W. Swanson (GE Co., Syracuse, N. Y.) *In* AGARD Radar Propagation in the Arctic Jan. 1972 22 p refs (See N72-21121 12-07)
(Contract f30602-69-C-0217)
Avail: NTIS HC $6.00/MF $0.95

Measurements made on HF sky wave signals propagated over two high-latitude 2000 nmi paths terminating at a receiving site in central New York State are presented. Signal characteristics include propagation loss, spectral spreading, and temporal spreading as a function of signal bandwidth (either 7.7 kHz or 100 kHz). The transmitting sites were located at Thule, Greenland and Keflavik, Iceland so that HF propagation information could be collected on a path that was both in the polar cap region and in midlatitude, and on one that passes along and through the outer edge of the auroral oval. Oblique soundings were conducted over each path so that the mode(s) of propagation for the signal(s) measured could be determined. Analyses of the results obtained indicated that the spectral and temporal spreading are a very strong function of the mode of propagation, especially for signals transmitted over the Thule path. The data are depicted as a function of time of day to illustrate the diurnal variation of the parameters considered. Author

**N72-21145#** Radio and Space Research Station, Slough (England).

**POLARIZATION EFFECTS ON SKY-WAVE PATHS AT HIGH LATITUDES**

P. A. Bradley *In* AGARD Radar Propagation in the Arctic Jan. 1972 9 p refs (See N72-21121 12-07)

Avail: NTIS HC $6.00/MF $0.95

The principles involved in the determination of polarization coupling losses on sky-wave paths are briefly discussed. The way these losses depend on the limiting polarizations of the upgoing and downcoming waves at the bottom of the ionosphere are illustrated, and it is shown that at frequencies in excess of about 2 MHz simple expressions are available for these limiting polarizations which are independent of the form of the ionization profiles. Limiting polarizations and polarization coupling losses are functions of wave frequency and of ray-path directions with respect to the direction of the earth's magnetic field. At high latitudes, changes in the angle between the field and ray path directions lead to marked variations in polarization coupling losses for nearby paths. Sample calculations are presented for a range of conditions to illustrate single- and two-way path losses. The calculations include the case of two-hop paths where there are additional features associated with the change of polarization at ground reflection. The results show the importance of the optimum choice of aerial polarization. The way in which backscatter amplitude return patterns can be influenced by polarization effects is also illustrated. Author

**N72-21146#** Air Force Cambridge Research Labs., L. G. Hanson Field, Mass.

**SPATIAL CORRELATION OF AURORAL RADIO ABSORPTION**

K. Toman, R. J. Cormier, and J. J. Corbett *In* AGARD Radar Propagation in the Arctic Jan. 1972 9 p refs (See N72-21121 12-07)

(Contract F19628-70-C-0237)

Avail: NTIS HC $6.00/MF $0.95

The temporal behavior of auroral radio absorption was measured with riometers at medium and high latitude displays complex patterns which differ spatially. These differences may be limited to a time displacement of otherwise similar absorption patterns indicating a movement which could be interpreted in terms of a structured, locally enhanced, precipitating, energetic particle stream that moves over a geographic area. In order to assess numerically the spatial coherence of auroral radio absorption, a correlation study was undertaken of absorption patterns as recorded by more than eight riometer stations during five days of varying activity containing the magnetic storm of 18 April 1965. Using a day as the sample size, the results of this study provide a view of the spatial coherence of auroral absorption. Author

**N72-21147#** Alaska Univ., College. Geophysical Inst.

**SWEEP FREQUENCY BACKSCATTER RADARS AS DETECTORS OF HIGH LATITUDE IONOSPHERIC PHENOMENA**

Howard F. Bates *In* AGARD Radar Propagation in the Arctic Jan. 1972 9p refs (See N72-21121 12-07)

Avail: NTIS HC $6.00/MF $0.95

Characteristics of irregularities causing high frequency scatter and propagation problems are examined, along with auroras producing these large and small scale irregularities. Auroral and nonauroral echoes were identified through high latitude, high frequency backscatter. Nonauroral echoes consist of F layer ground scatter, nonauroral sporadic E including E ground scatter, meteor echoes, and oblique spread F echoes. Auroral echoes were found to be caused by backscatter from both the E and F layers. J.A.M.

**N72-21148#** Technical Univ. of Denmark, Lyngby.

**ON THE POLAR SLANT E CONDITION, ITS IDENTIFICATION, MORPHOLOGY AND RELATIONSHIP TO OTHER ELECTROJET PHENOMENA**

Jens K. Olesen *In* AGARD Radar Propagation in the Arctic Jan. 1972 19 p refs (See N72-21121 12-07)

Avail: NTIS HC $6.00/MF $0.95

Ionograms and morphological statistics of polar slant E condition are discussed, emphasizing two stream or plasma ion wave instability. Observation sites and data periods for ionosonde and fixed frequency scatter measurements are also listed. J.A.M.

**N72-21149#** Paris Univ. (France).

**HIGH FREQUENCY BACKSCATTER OBSERVATIONS AT MEDIUM LATITUDES OF HIGH LATITUDE FIELD ALIGNED IRREGULARITIES**

M. Crochet, D. Barreau, and J. C. deMaistre *In* AGARD Radar Propagation in the Arctic Jan. 1972 9 p refs In FRENCH; ENGLISH summary (See N72-21121 12-07)

Avail: NTIS HC $6.00/MF $0.95

Abnormal echoes ascribable to the presence of field aligned high latitude irregularities in the F layer were frequently observed from the Valensole station (44 deg N, 6 deg E), by means of decametric wave backscatter radar. A comparison of characteristic recordings with data collected simultaneously at the Lindau station (51 deg N, 10 deg E) where such echoes are regularly obtained reveals the influence of the station latitude on the observation of such phenomena. Author

**N72-21150#** Air Force Cambridge Research Labs., L. G. Hanson Field, Mass.

**HF AURORAL BACKSCATTER AND THE SCINTILLATION BOUNDARY**

Jules Aarons *In* AGARD Radar Propagation in the Arctic Jan. 1972 11 p refs (See N72-21121 12-07)

Avail: NTIS HC $6.00/MF $0.95

A 19 MHz backscatter unit was operated, and a series of measurements of radio star scintillations (30 to 228 MHz) and satellite beacon recordings (20 to 136 MHz) were made. A 50 MHz radar was added to the observing program. In a recent analysis of the dual frequency field aligned backscatter, a separation into E and F-layer returns was made. It was found that VHF auroral returns (from E-layer heights) were accompanied 49% of the time by HF returns. The two factors suggested to be responsible for the absence of a 1:1 correlation were probably absorption at HF and variations in antenna launch angle for the two systems. The HF auroral backscatter (E and F-layer heights) was accompanied only 11% of the time by VHF backscatter. During the 17 months of observation at low solar activity, the percentage of occurrence of 19 MHz field aligned scatter was 2%; of 50 MHz auroral scatter 0.5%. Author

**N72-21151#** Avco Corp., Wilmington, Mass.

**FM/CW HF BACKSCATTER OBSERVATIONS OF RADIO AURORA**

A. H. Katz *In* AGARD Radar Propagation in the Arctic Jan. 1972 8 p refs (See N72-21121 12-07)

(Contract F30602-70-C-0086)

Avail: NTIS HC $6.00/MF $0.95

Observations of HF backscatter from radio aurora using an FM/CW radar located at field sites near Rome, N. Y. (43.2 deg N, 75.5 deg W) are discussed. Both wideband (at 6.5-30 MHz, 3 kW average power) and narrowband (fixed frequency soundings at 20 kW average power) backscatter measurements were made. The wideband soundings determine the modes of propagation, frequency extents, and time delays of the backscattered energy. The high resolution narrowband soundings indicate the movements that occur in the radio auroral regions. Examples of these motions are presented, showing events that last for 5 minutes, exhibiting range changes which imply apparent velocities near or above the speed of sound at F-region heights. The wideband backscatter measurements were processed in a form which allows the absolute signal level of the backscattered energy to be determined. Author

N72-21152# General Electric Co., Syracuse, N.Y.
**IONOSPHERIC REFRACTION EFFECT ON THE GEOMETRY OF FIELD-ALIGNED IONIZATION**
George H. Millman *In* AGARD Radar Propagation in the Arctic Jan. 1972 15 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

A method is presented which utilizes the concept of the ionospheric refraction phenomenon in the calculation of the magnetic field-propagation aspect angle. The effect of ionospheric refraction at frequencies in the HF-UHF band is evaluated for one location in the Northern Hemisphere. Author

N72-21153# Institute for Telecommunication Sciences, Boulder, Colo.
**A MODEL FOR THE STUDY AND PREDICTION OF AURORAL EFFECTS ON HF RADAR**
Vaughn Agy *In* AGARD Radar Propagation in the Arctic Jan. 1972 10 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

A description is given of an ionospheric propagation model and its application to high latitude HF radar propagation. Computer simulation of the model makes possible the rapid determination of the area of (1-hop) coverage, and computation of auroral absorption and geometrical features of auroral clutter. The results are presented in a map on which are shown appropriate parameter contours. Operating frequency, station location, time, month, sunspot number, and clutter height are all arbitrary. The explicit approximations specifying the model can be changed within the basic framework of the computer program to bring about better agreement with observations. Author

N72-21154*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**A STUDY OF THE FRICTIONAL AND STICK-SLIP BEHAVIOR OF MAGNETIC RECORDING TAPES**
S. H. Kalfayan, R. H. Silver, and J. K. Hoffman 1 Apr. 1972 30 p refs
(Contract NAS7-100)
(NASA-CR-125930; JPL-TR-32-1548) Avail: NTIS CSCL 14C

Methods were developed to determine the coefficient of friction and the extent of stick-slip of magnetic recording tapes. After a preliminary phase during which experimental procedures were established and screening of candidate tapes was carried out, the frictional and stick-slip behavior of four selected tapes, using four different kinds of magnetic heads, was studied at various temperatures, under dry and humid conditions, and in various gaseous atmospheres, such as argon, helium, nitrogen and air. The effects of tape speed and outgassing on the drag properties of the tapes were also studied. A rank was assigned to each tape and magnetic head as a result of these tests. This study helped in the selection of a magnetic tape in a flight project, and will be useful in the consideration of tapes and magnetic heads for future spacecraft applications. Author

N72-21155*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**MULTI-PURPOSE ANTENNA Patent Application**
Kenneth E. Woo, inventor (to NASA) Filed 12 May 1970 16 p (Contract NAS7-100)
(NASA-Case-NPO-11264; US-Patent-Appl-SN-36531) Avail: NTIS CSCL 17B

A description is given of a microwave antenna, useful on a spacecraft, which utilizes a single dish reflector and single coaxial horn structure to transmit at two frequencies, and to receive signals at a third frequency that allow tracking. The horn structure include a coaxial waveguide with an inner pipe for transmitting X-band waves, an intermediate pipe surrounding the inner pipe for transmitting S-band waves through the space between it and the inner pipe, and an outer pipe surrounding the intermediate pipe for receiving S-band tracking signals. An outer horn flares from the outer pipe and an inner horn flares from the inner pipe, to efficiently illuminate the dish reflector at both X- and S-bands. NASA

N72-21156# Joint Publications Research Service, Arlington, Va.
**RADAR ENGINEERING**
4 Apr. 1972 10 p refs Transl. into ENGLISH from Radioelektronika (Kiev), v. 10, nos. 5 and 6, 1967
(JPRS-55618) Avail: NTIS

Translations of two Russian articles on radar engineering are presented. The subjects discussed are: (1) the effect of external noise on angular resolution of highly directional antennas, and (2) the effect of a radome subjected to heat shock on the range of a radar station. Mathematical models and numerical analyses are included to support the theoretical considerations. For individual titles, see N72-21157 through N72-21158.

N72-21157# Joint Publications Research Service, Arlington, Va.
**APPRAISAL OF EFFECT OF EXTERNAL NOISE UPON ANGULAR RESOLUTION OF HIGHLY DIRECTIONAL ANTENNAS**
Ye. A. Vorobyev *In its* Radar Eng. 4 Apr. 1972 p 1-3 refs (See N72-21156 12-07)
Avail: NTIS

The effect of external noise on the angular resolution of highly directional radar antennas is discussed. It is determined that the high level of external noise is due to the diffusion of radiation of the soil or water surface and the effect of the radome. Mathematical models to support the nature and degree of error introduced by external noise are presented. The quality of the radome is considered to have a considerable effect on the real angular resolution of the antenna and particular attention to the dielectric properties during design is required. Author

N72-21158# Joint Publications Research Service, Arlington, Va.
**EFFECT OF RADOME SUBJECTED TO A HEAT SHOCK UPON RANGE OF A RADAR STATION**
V. F. Mikhaylov *In its* Radar Eng. 4 Apr. 1972 p 4-8 refs (See N72-21156 12-07)
Avail: NTIS

An analysis of the effects of a radome subjected to heat shock on the range of a radar station is presented. It is determined that radome temperature varies along its generatrix and thus the radar station range will be different for different angles of antenna rotation. Variation of the physical parameters of the antenna radome wall during its aerodynamic heating leads to a decrease in the radar range of the ground station. Mathematical models and numerical analyses are included to support the theoretical considerations. Author

N72-21159*# National Oceanic and Atmospheric Administration, Boulder, Colo.
**DETERMINING DISTANCE TO LIGHTNING STROKES FROM A SINGLE STATION Patent Application**
Lothar H. Ruhnke, inventor (to NASA) Filed 30 Dec. 1971 14 p Sponsored by NASA
(NASA-Case-KSC-10698-1; US-Patent-Appl-SN-213949) Avail: NTIS CSCL 17B

The apparatus includes a first loop antenna system for sensing the magnetic field produced by the lightning. The signal is filtered, square rooted, and fed into a peak voltage holding circuit. A second antenna is provided for sensing the electric field produced by the lightning which is fed into a filter, an absolute value meter, and to a peak voltage holding circuit. A multivibrator gates the magnetic and electric signals through the peak holding circuits to a ratio meter, which produces a signal corresponding to the ratio between the magnetic component and the electric component. The amplitude of this signal is proportional to the distance from the apparatus to the lightning stroke. NASA

N72-21160*# Sperry Rand Corp., Huntsville, Ala.
**FREQUENCY DIVISION MULTIPLEX TECHNIQUE Patent Application**
Hans Brey, inventor (to NASA) Filed 28 Dec. 1971 41 p (Contract NAS10-6278)

(NASA-Case-KSC-10521-1; US-Patent-Appl-SN-212921) Avail: NTIS CSCL 17B

A sysem is described for monitoring a number of condition-responsive devices. It consists of a master control station and a remote station. The master control station is capable of transmitting command signals, which include a parity signal to a remote station. The remote station transmits the signals back to the command station so that they can be compared with the original signals to determine if there are any transmission errors. The system utilizes frequency sources withic are 1.21 multiples of each other, so no linear combination of any harmonics will interfere with another frequency. NASA

**N72-21161*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**INTRUDER DETECTION SYSTEM Patent Application**

Robert D. Lee, inventor (to NASA) Filed 12 Feb. 1971 22 p (NASA-Case-ARC-10097-2; US-Patent-Appl-SN-115083) Avail: NTIS CSCL 17B

An intruder detection system, is described in which a transmitter transmits a frequency modulated and amplitude modulated signal to a remote receiver in response to a transducer, such as a geophone detector, picking up seismic impulses created by one or more intruders. In this manner, an operator listening to the receiver can identify the number of intruders, and also can identify the movements of the intruder or intruders, such as walking, running and the like. NASA

**N72-21162#** AEG-Telefunken, Ulm (West Germany). Fachbereich Hochfrequenztechnik.

**THE TRANSMITTING/RECEIVING SYSTEM OF THE SOLAR PROBE HELIOS [DAS SENDE/EMPFANGSSYSTEM DER SONNENSONDE HELIOS]**

G. B. Go Cologne DGLR 1971 25 p In GERMAN Presented at the 4th DGLR Annual Meeting, Baden-Baden, West Ger., 11-13 Oct. 1971

Avail: NTIS

A description is given of the Helios solar probe transmitter-receiver equipment. The ratio of transmit and receive frequency is 240/221. The system enables four essential operations: telemetry transmission to ground stations, command reception, phase coherent frequency conversion of received carrier to measured Doppler shift and relation velocity, and ranging signal reception and transmission. A description is given of the system specifications and the equipment involved. ESRO

**N72-21163#** Research Inst. of National Defence, Stockholm (Sweden).

**MICROWAVE RADIOMETRY AND ITS POTENTIAL APPLICATION TO EARTH RESOURCES SURVEYS. KNOWLEDGE OF MATERIAL PROPERTIES NEEDED FOR ANALYSIS OF MICROWAVE RADIOMETRIC DATA**

Torleiv Orhaug Linkoeping Saab Scania Dec. 1971 67 p refs (Contract ESTEC-1411/71-EL)

(RAC-0-3-R16; ESRO-CR(P)-74) Avail: NTIS

The theory of thermal microwave noise generation from solids and gases is summarized. The influence of the various material properties is discussed, particularly for a conducting glossy object where the Fresnel coefficient can be used for predicting brightness properties. The effect and the characteristics of atmospheric noise are discussed and examples of microwave observations of atmospheric noise given. The scattering properties of an object having a rough surface are described with emphasis laid on the limitations of theoretical analysis. The generation of noise from rough surfaces is also treated. The polarization effect to be expected from glossy and rough surfaces is treated, and the influence of atmospheric noise discussed. The effects on thermal noise caused by sub-surface inhomogeneities and by time-varying heating are discussed. A summary of present programs and knowledge in this field is given, together with recommendations for future work. Author (ESRO)

**N72-21164#** Microwave and Electronic Systems Ltd., Edinburgh (Scotland).

**DEVELOPMENT OF A MULTIPLEXING NETWORK Interim Report**

I. M. Alexander, R. M. Easson, J. Helszajn, and R. S. Tahim Paris ESRO Aug. 1971 117 p refs

(Contract ESTEC-1218/70)

(ESRO-CR-46) Avail: NTIS

A design procedure established which enabled the optimum number of resonators to be calculated for four types of diplexer. Using these results the odd and even mode impedances and the coupling coefficients for the various filters required by each diplexer were calculated and the specific physical dimensions of filters constructed of different types of resonator were computed. An exhaustive study of resonator technologies was undertaken, and fourteen types of resonator were considered in detail. In each case application to each of the four types of diplexer was studied with particular regard to unloaded Q, insertion loss, dimensions, weight, temperature stability and power handling capability. Results are summarized in tabular form. The conclusions reached are: First, filters based on distributed transmission lines are more suitable for the overall sub-system than those containing discrete components. Second, the most satisfactory multiplexer using conventional techniques would contain a complementary filter diplexer constructed in stripline. Third, of the newer transmission media, coplanar waveguide appears to be the most attractive. Author (ESRO)

**N72-21165#** Transportation Systems Center, Cambridge, Mass.

**A REVIEW OF AVAILABLE L-BAND AND VHF AIRCRAFT ANTENNAS FOR AN AIRCRAFT SATELLITE COMMUNICATIONS LINK**

May 1971 93 p refs

(PB-204799; DOT-TSC-OST-71-8) Avail: NTIS CSCL 09E

One of the problems encountered in designing an aircraft to use a satellite system for communications (and for surveillance and navigation) is that of finding a suitable aircraft antenna. There is, at present, no antenna which will satisfy all requirements. The characteristics of some of the L-Band and VHF antennas which have been proposed for an aircraft-satellite link are reviewed. Author (GRA)

**N72-21166#** Technische Hochschule in Graz (Austria). Inst. Fuer Theoretische Physik.

**LOW FREQUENCY LOOP ANTENNA ARRAYS, PART 2 Final Report**

Ernst Ledinegg Nov. 1971 32 p

(Contract DAJA37-70-C-0118; DA Proj. 200-61102-B-11-B)

(AD-734599; ARDG(E)-E-1346-Pt-2-Add) Avail: NTIS CSCL 09/5

The radiation characteristics of horizontal loop antenna arrays was using a step width of 0.5 degrees for both the polar angle and the azimuth. It can be easily shown that it sufficices to examine a few types of arrays which reflect the radiation properties of all other types. The antenna array consists of N (N-100) horizontal loop antennas which all have the same height above ground and which are arranged in a line with equal spacing. GRA

**N72-21167#** Ohio State Univ., Columbus. Electroscience Lab.

**TDMA SPACE COMMUNICATIONS SYSTEMS: CONCEPTS AND PRACTICAL TECHNIQUES**

Ronald J. Huff Nov. 1971 122 p refs

(Contract F30602-69-C-0112)

(AD-734255; ESL-2738-4; RADC-TR-71-255) Avail: NTIS CSCL 17/2

The results of investigations conducted over the past five years directed at the development of practical techniques for instrumenting TDMA systems are placed in perspective. The rationale for selecting the particular TDMA concept developed, the advantages and limitations of the associated techniques, the design options available, and potential concept applications are presented in varying degrees of detail. It is shown that, through

the use of differential detection to demodulate the data-carrying pulses and sampled-data delay-lock loops to accurately time the up-links, a TDMA system which is efficient, effective, and flexible can be instrumented. Procedures for using the previously documented technological base to design two hypothetical systems are illustrated. Satellite processing concepts which are compatible with the basic TDMA techniques developed are described. Author (GRA)

N72-21168# White Sands Missile Range, N.Mex.
**SECURE COMMUNICATIONS AT MILLIMETER WAVELENGTHS**
Richard G. Murray Nov. 1971 21 p
(DA Proj. 10S-6-34701-D-257)
(AD-735686; ECOM-5412) Avail: NTIS CSCL 17/2

The millimeter wavelength spectrum is being utilized more and more to fill specific communication needs to take advantage of the larger bandwidths available and the smaller antenna sizes required. Although the low atmospheric attenuation 'windows' in the millimeter spectrum are most commonly used, it is feasible to use the high attenuation bands to provide an excellent degree of security from unwanted interference or clandestine intercept. Examination of a typical one-kilometer ground communication link at 50 GHz using currently available hardware indicates a high degree of security under virtually all weather conditions. GRA

N72-21169# Washington Univ., Seattle. Dept. of Electrical Engineering.
**MULTIPLE SCATTERING EFFECTS ON WAVE PROPAGATION IN ISOTROPIC SCATTERING MEDIA**
James C. Lin and Akira Ishimarv Mar. 1971 41 p refs
(Contract F19628-69-C-0123; AF Proj. 8682)
(AD-735284; AFCRL-71-0248; TR-143; SR-3) Avail: NTIS CSCL 20/14

The multiple scattering effects of wave propagation in an isotropically scattering random distribution of discrete scatterers are considered. The integral equations for the coherent field and average intensity are solved using Fourier transform techniques. An 'influence function' is obtained for the average intensity, which can be used as the Green's function for the solution of average intensity of any given source radiation. Explicit expressions are given for plane, spherical and beam waves showing the dependence on various wave and medium parameters. Curves demonstrating the general characteristics of the solutions are presented for different albedos (the ratio of scattering to total cross sections). Author (GRA)

N72-21170# New York Univ., N.Y. Courant Inst. of Mathematical Sciences.
**RESEARCH STUDIES IN THE THEORY OF SCATTERING OF ELECTROMAGNETIC WAVES BY METALLIC OBJECTS Final Report, 1 Jan. 1969 - 30 Jun. 1971**
Joseph B. Keller Jul. 1971 252 p refs
(Contract F19628-69-C-0117; AF Proj. 5635)
(AD-735287; AFCRL-71-0503) Avail: NTIS CSCL 20/14

The object of the research was to extend existing knowledge of classical electromagnetic theory with emphasis on the problem of determining the phase and amplitude of the electromagnetic field scattered by a conducting body, and using knowledge of the scattered phase and amplitude to determine the size and shape of the body. The investigations pertaining to these problems are explained in the body of this report. Author (GRA)

N72-21171# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
**PENNSYLVANIA-PRINCETON ARMY AVIONICS RESEARCH PROGRAM: ANTENNA RESEARCH TASK Final Technical Report**
Richard F. Schwartz, Frank Klusek, Dennis L. Knepp, and Julius Goldhirsh Oct. 1971 186 p refs
(Contract DA-28-043-AMC-02411(E); DA Proj. 1H1-62202-A-219)
(AD-735346; ECOM-02411-24; Rept-72-08) Avail: NTIS CSCL 09/5

The principal results of the work were the development of numerical-analytical techniques for predicting the radiation patterns and impedance of given antennas when mounted on aircraft and the detailed study of the effects of outboard members of the aircraft structure on radiation patterns. Extensions of the numerical-analytical techniques developed are suggested. Conclusions are drawn about the spacing of antennas from obstacles to minimize interaction and a possible new antenna interaction is proposed. Various studies peripheral to the main effort are also described. Author (GRA)

N72-21172# Army Electronics Command, Fort Monmouth, N.J.
**EXPERIMENTAL INVESTIGATION OF COMPACT GROUND-BASED HIGH FREQUENCY ANTENNA**
D. V. Campbell Sep. 1971 34 p refs
(DA Proj. 1T0-61102-B-31-A)
(AD-735679; ECOM-3489) Avail: NTIS CSCL 09/5

A compact, low silhouette, portable high frequency antenna (experimental) for ground-to-ground communication was developed, tested, and found to launch ground waves effectively. Tuning and matching can be accomplished over a large portion of the high frequency range by integrating loading inductors with the radiating element. Ground losses are minimized by exciting the radiator against a counterpoise. Feedline radiation and associated power loss are prevented by a broad-band cable choke. Radiation efficiency of the compact HF antenna is comparable to that of the much larger reference antenna. Compact HF antennas have been combined too for an efficient closely-spaced array having greatly reduced ground losses. Author (GRA)

N72-21173# Army Electronics Command, Fort Monmouth, N.J.
**GROUND-LOSS REDUCTION AT HIGH FREQUENCIES THROUGH THE USE OF ANTENNA ARRAYS**
C. M. De Santis and F. Schwering Dec. 1971 58 p refs
(DA Proj. 1T0-61102-B-31-A)
(AD-735682; ECOM-3518) Avail: NTIS CSCL 09/5

High frequency antenna arrays are shown to reduce the effect of conduction losses normally associated with an antenna operating on or in proximity to the surface of the earth. It is demonstrated that the normal directivity gain as a function of array element spacing is modified by the presence of the finite conducting earth, and that at the lower frequencies in the HF range the gain of the array increases rapidly as the element spacing is increased from zero (single dipole) to about 1/10 of a wavelength. At this spacing, the gain approaches a limit which for low conductivities is close to a theoretical upper bound equal to the number of elements in the array. Author (GRA)

N72-21174# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
**THE POTENTIAL OF THE US NAVY NAVIGATION SATELLITE SYSTEM IN THE PREDICTION OF IONOSPHERIC CHARACTERISTICS FOR HIGH FREQUENCY SKY WAVE TELE-COMMUNICATIONS**
V. L. Pisacane and M. M. Feen Aug. 1971 28 p refs
(Contract N00017-72-C-4401)
(AD-735866; APL-TG-1182) Avail: NTIS CSCL 17/2

The paper discusses the potential of the Navy Navigation Satellite System in predicting the optimum transmitting parameters in high frequency sky wave telecommunications. First, the operational navigational system, which consists of spacecraft, tracking stations, a computational center and a broad spectrum of user equipment, is discussed. Next, the propagation effects of the ionosphere on the satellite radio-doppler observations are considered. Then, the various invasive and non-invasive options of utilization of the navigation system in obtaining ionospheric data are given. Author (GRA)

**N72-21175#** Naval Electronics Lab. Center, San Diego, Calif. Propagation Technology Div.
**HF PROPAGATION DEGRADATION DURING IONOSPHERIC STORMS Research and Development Report, May - Jul. 1971**
R. B. Rose 24 Aug. 1971 43 p refs
(WF Proj. 48-222-701; NELC Proj. M207)
(AD-735868; NELC-TR-1782) Avail: NTIS CSCL 17/2

A comparison of storm effects over eight Pacific oblique sounder paths provides guidelines for spectrum utilization for the Naval communication station communicator and traffic manager. HF circuit degradation due to ionospheric storms is shown to be latitude-dependent. During severe disturbance periods the existing HF usable spectrum is highly unstable. HF frequencies in the middle of the normal daytime usable spectrum have the highest probability of survival, but point-to-point oblique sounding is the only reliable method for maintaining maximum transmission circuit availability during storm periods. Author (GRA)

**N72-21176#** Naval Air Development Center, Johnsville, Pa. Aero-Electronic Technology Dept.
**EFFICIENCY STUDY OF ELECTRICALLY SHORT H-F ANTENNAS**
Gerald Palatucci 17 Nov. 1971 54 p refs
(AD-735886; NADC-AE-7112) Avail: NTIS CSCL 09/5

The requirements for h-f communication systems are becoming more stringent especially for small aircraft such as the F-14 and S-3. To optimize the transmitter power budget, the relative efficiency of various antenna configurations including the coupling circuits required to match the antenna to the transmitter has been compared in this analytic study. Author (GRA)

**N72-21177#** Air Force Cambridge Research Labs., L. G. Hanson Field, Mass.
**SCATTERING OF HF RADIO WAVES BY A SPHERICAL ELECTRON CLOUD IN THE PRESENCE OF A MAGNETIC FIELD**
Milton M. Klein and Norman W. Rosenberg 30 Apr. 1971 35 p refs
(AF Proj. 7635)
(AD-735265; AFCRL-71-0371; AFCRL-ERP-360) Avail: NTIS CSCL 20/14

The scattering of HF radio waves by a spherical electron cloud in the presence of a magnetic field has been obtained in ray optics approximation for a Gaussian distribution of electron density. The objective of this report is to provide knowledge and understanding of the effect of the earth's magnetic field upon the propagation of electromagnetic waves through the ionosphere, ionospheric irregularities, and artificial electron clouds. It is thus directed to the furnishing of data, together with criteria, for the solution of Air Force problems of discrimination, detection, and communication. Author (GRA)

**N72-21178#** Army Electronics Command, Fort Monmouth, N.J.
**SIGNAL PROPAGATION AT 400 kHz USING AN OAK TREE WITH A HEMAC AS AN ANTENNA**
Kenneth A. Skrivseth Nov. 1971 15 p
(DA Proj. 1H6-62701-A-448)
(AD-735330; ECOM-3504) Avail: NTIS CSCL 09/5

A HEMAC (Hybrid Electromagnetic Antenna Coupler) is used to couple r-f energy in the medium frequency range (40-425 kHz) to an oak tree that is used as an antenna. A discussion of the measured impedance data and the effects of the nearby terrain are presented along with the conclusions reached. Author (GRA)

**N72-21179#** Air Force Cambridge Research Labs., L. G. Hanson Field, Mass.
**BLIND SPOT OCCURRENCE IN PHASED ARRAYS: WHEN TO EXPECT IT AND HOW TO CURE IT**
Robert J. Mailloux 11 Aug. 1971 19 p refs
(AF Proj. 4600)
(AD-735653; AFCRL-71-0428; AFCRL-PSRP-462) Avail: NTIS CSCL 09/5

The paper reviews the present state of knowledge concerning radiation pattern nulls, with a view toward anticipating its occurrence and avoiding or minimizing the effects. In addition, data are presented that describe a new kind of blind spot wherein both the main beam and a grating lobe are simultaneously null, and some new data are included that show an array null can be removed by destroying the symmetry of the array periodic cell. Author (GRA)

**N72-21180#** Army Electronics Command, Fort Monmouth, N.J.
**MODELLING OF HF-VHF RADIO TRANSMISSION IN JUNGLE FOREST COVERED TERRAINS Final Report**
Kurt Ikrath and Granville LeMeune Nov. 1971 34 p refs
(DA Proj. 1H6-62701-A-448)
(AD-735335; ECOM-3512) Avail: NTIS CSCL 17/2

The structure and natural random growth of grasses, herbs and shrubs are utilized to model with microwaves, HF and VHF radio transmission phenomena which occurs in actual jungle forests communications link. Author (GRA)

**N72-21181#** Signatron, Inc., Lexington, Mass.
**PROBLEMS AND SOLUTIONS IN STATISTICAL DETECTION AND ESTIMATION Final Scientific Report**
Julian J. Bussgang and Nicolas Johnson Oct. 1971 175 p refs
(Contract F44620-69-C-0039; AF Proj. 9749)
(AD-735760; AFOSR-72-0141-TR) Avail: NTIS CSCL 12/1

The purpose of the report is to present to the student and practicing scientist a collection of self-contained problems and solutions in statistical detection and estimation. The problems have been selected to illustrate the points that most often bother practicing engineers interested in the subject and to which they find no ready answers in the existing text-books. The range of applications vary over signal detections, communication theory, parameter estimation, and network analysis. Author (GRA)

**N72-21182#** Federal Scientific Corp., New York.
**IMPLEMENTATION OF AN ON-LINE SYSTEM FOR AUTOMATIC RECOGNITION OF SPOKEN WORDS Final Technical Report**
Mark R. Weiss, Thomas W. Parsons, and Ernest Aschkenasy Griffiss AFB, N. Y. RADC Dec. 1971 127 p refs
(Contract F30602-68-C-0171)
(AD-735723; FSC-F/195; RADC-TR-71-287) Avail: NTIS CSCL 17/2

The report describes the implementation of a system which automatically recognizes spoken words in near real time. The techniques on which the system is based were developed over a period of 10 years. During most of this time, the research activities were devoted to the problems of selecting, extracting, and utilizing essential information-bearing parameters of speech. A non-real-time version of the speech analysis and recognition techniques which were developed was tested and demonstrated in 1967. Subsequently, the objective was shifted to implementing an on-line speech recognition system. An initial version was completed in 1969. Since then, the final objective of this long-term effort has been to improve the effectiveness of the analysis and classification procedures, speed their operation, and provide the user with wide flexibility in the operation of the system. The system described was implemented in a DDP-116 computer and is capable of learning and recognizing a vocubulary of 100 words of up to three syllables each. Author (GRA)

**N72-21183#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**INTRODUCTION TO THE ELECTROMAGNETIC PULSE M.S. Thesis**
Otho V. Kinsley Mar. 1971 199 p refs
(AD-735654; GNE/PH/71-4) Avail: NTIS CSCL 20/14

The thesis constitutes an introductory survey of the

electromagnetic pulse (EMP) caused by a nuclear weapon burst. The survey is separated into driving mechanism, the electric field of the symmetric nuclear burst, the electromagnetic field from bursts whose environment is asymmetric due to density variations or the geomagnetic field's presence, pulse transmission, and pulse interaction. This survey was collected from the unclassified literature and is presented here in a consistent notation and language. The presentation is intended to emphasize concepts and understanding and is not intended as a design handbook. To this end the author has attempted some mathematical simplification of certain phenomena. These simplified models are identified when employed and the results obtained are compared to those found in the literature which result from test data or from more exact mathematical models. Author (GRA)

**N72-21184#** System Development Corp., Santa Monica, Calif.
**A SURVEY OF DIGITAL SIGNAL PROCESSING TECHNIQUES FOR SPEECH ANALYSIS Technical Report, Jul. - Dec. 1971**
H. Barry Ritea 5 Jan. 1972 6 p
(Contract DAHC15-67-C-0149; ARPA Order 1327)
(AD-735919; SDC-TM-4857/001/00) Avail: NTIS CSCL 17/2

The document provides an introduction for document TM-4857, a survey of digital signal processing techniques for speech analysis. Author (GRA)

**N72-21185#** System Development Corp., Santa Monica, Calif.
**THE CEPSTRUM, THE CEPSTRALLY SMOOTHED LOG SPECTRUM AND THE CHIRP Z-TRANSFORM Technical Report, Jul. - Dec. 1971**
H. Barry Ritea 5 Jan. 1972 23 p refs
(Contract DAHC15-67-C-0149; ARPA Order 1327)
(AD-735921; SDC-TM-4857/200/00) Avail: NTIS CSCL 17/2

Several digital signal processing algorithms useful in speech research are presented: The cepstrum pitch detector; The cepstrally smoothed log spectrum; The Chirp Z-transform. FORTRAN codes and examples accompany the discussions. Author (GRA)

**N72-21186#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**CAPABILITIES AND LIMITATIONS OF INFRARED VIDICONS VERSUS INFRARED SCANNING SYSTEMS**
John O. Dimmock 3 Dec. 1971 43 p refs
(Contract F19628-70-C-0230; AF Proj. 649L)
(AD-735324; TN-1971-49; ESD-TR-71-318) Avail: NTIS CSCL 17/2

The performances of infrared television camera tubes and infrared scanning systems are compared as a function of background photon flux density. Author (GRA)

**N72-21187#** Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
**SPEECH UNDERSTANDING SYSTEMS Final Report**
A. Newell, J. Barnett, J. Forgie, C. Green, D. Klatt, J. C. R. Licklider, J. Munson, R. Reddy, and W. Woods May 1971 146 p refs
(Contract F44620-70-C-0107)
(AD-735758; AFOSR-72-0142TR) Avail: NTIS CSCL 17/2

The report provides an evaluation of the state of the art and a program for research towards the development of speech understanding systems. To assess the possibility of such systems four specific tasks were considered and evaluated. Problem areas are identified and discussed leading to the conclusions on the technical aspects of the study. A possible program for research and development is presented. Author (GRA)

**N72-21188#** Kansas Univ., Lawrence. Center for Research.
**PROJECT THEMIS: A CENTER FOR REMOTE SENSING Semiannual Technical Report, Mar. - Sep. 1971**
F. T. Ulaby, comp. Sep. 1971 142 p refs
(Contract DAAK02-68-C-0089)
(AD-735752; CRES-TR-133-24; ETL-CR-71-21; SATR-8) Avail: NTIS CSCL 17/9

The report summarizes the technical progress under the subject contract on a broad interdisciplinary effort for the improvement of user utility of remotely sensed data. This effort involves theoretical work, sensor development, processing and display, and data analysis for specific user application. A number of technical reports and memoranda describing work underway are attached. Author (GRA)

**N72-21189#** Melpar, Inc., Falls Church, Va.
**INVESTIGATION OF SPEECH PATTERN-MATCHING Final Report, Aug. 1969 - Jul. 1971**
William J. Richter, Jr., Oliver C. King, Francis C. Crotty, Jr., and Edwin L. Pfau Sep. 1971 32 p
(Contract F19628-70-C-0022; AF Proj. 4610)
(AD-735308; FR-9184) Avail: NTIS CSCL 17/2

The report contains the results of an investigation of speech pattern-matching using a digital voice data processor to evaluate pattern-matching speech bandwidth compression techniques. The capability and flexibility of the Voice Data Processor System (VDPS) was increased to include the following features: A modification was designed to provide a real-time CRT display of selected VDPS parameters; the AFCRL Linc Processor was interfaced with the VDPS; a modification was made to reinsert silent frames into the output from silence-edited digital tapes as they are run in a tape input mode; the capability of editing out the onset portions of words of speech in real-time has been added to the system. In addition, the results of studies on increasing VDPS flexibility and memory capacity are presented, to accommodate the research on the effects of speaker selection. Author (GRA)

**N72-21190#** Advanced Technology Systems, Inc., Arlington, Va.
**A SURVEY AND ANALYSIS OF CITIZENS RADIO SERVICE Final Report**
23 Apr. 1971 102 p refs
(Contract FCC-RC-10134-70)
(PB-204595) Avail: NTIS CSCL 17B

The report surveys the need for changes in Federal Communications Commission Rules governing operating procedure in the Citizens Radio Service. Changes are recommended that would permit better advantage to be taken of the multiple channels available in this service. Recommendations are also made that would establish an enforcement program to eliminate those types of illegal use and violations that are degrading in the Citizens Radio Service. Author (GRA)

**N72-21191#** Automated Marine International, Newport Beach, Calif.
**MARITIME SERVICES SATELLITE SYSTEM DEFINITION STUDY Final Report, 17 Nov. 1970 - 1 Aug. 1971**
B. A. Mendoza, D. C. Lawson, G. P. Heckert, and J. D. Luse Aug. 1971 390 p refs
(Contract DOT-TSC-98)
(PB-204860) Avail: NTIS HC $6.00/MF $0.95 CSCL 17B

The report reviews the requirements for voice and data communications to and from merchant ships at sea, for the period through 1980, and concludes that a global coverage satellite system of three synchronous satellites, each with a 10 voice-channel capacity, will meet forecast requirements provided that a disciplined demand access scheme is implemented. The present spacecraft technology is reviewed and certain critical spacecraft subsystem design criteria are assessed. The shipboard terminal is reviewed in detail, and the basic design constraints are established. The report concludes that an independent maritime satellite communications system is not only feasible with today's technology but inevitable, and that final definition and design of appropriate hardware should be undertaken at once. Author (GRA)

**N72-21192#** Naval Postgraduate School, Monterey, Calif.
**MODELS FOR MESSAGE TRANSMISSIONS AND INTERFERENCE-CAUSED RETRANSMISSION THROUGH A MULTI-CHANNEL SATELLITE COMMUNICATIONS SYSTEM M.S. Thesis**
Charles William Jones Sep. 1971 37 p refs
(AD-736115) Avail: NTIS CSCL 17/2

A satellite communication system has been proposed for use in improving naval communications. This system would feature random selection of channels by originators. An expression is developed for the probability that a specified number of messages, s, of n original messages, will be received successfully after being transmitted a number of times, m. An expression is derived for the probability that a specified number of messages, j, of n original messages, will be received successfully on the first transmission by some arbitrary time, T. A Monte Carlo computer simulation is conducted and is the basis for expressions for the maximum number of times any unit would have to transmit to be received successfully. Author (GRA)

**N72-21193#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**LIMITED ELECTRONIC SCANNING WITH AN OFFSET-FEED NEAR-FIELD GREGORIAN SYSTEM**
W. D. Fitzgerald 24 Sep. 1971 31 p refs
(Contract F19628-70-C-0230; DA Proj. 7X2-63304-D-215)
(AD-736029; TR-486; ESD-TR-71-272) Avail: NTIS CSCL 09/5

The scanning characteristics of an offset-feed near-field Gregorian antenna excited with a planar array are investigated. The analysis is based on the assumption that the fields in the near-zone region of the array can be accurately determined by the methods of ray optics, i.e., geometrical propagation along ray trajectories. Scalar diffraction theory is used to compute secondary characteristics. For one example considered, a 1/2 degree beam is scanned over a cone with a half angle of approximately 7 degrees as defined by the -3 db scan-loss criterion. The effects of changing parameters (magnification, reflector sizes, frequency, etc.) on the scan characteristics are discussed. An experiment which was performed to demonstrate the technique is described. Author (GRA)

**N72-21194#** Aerospace Corp., El Segundo, Calif. Office for Technology.
**FEASIBILITY STUDY OF A WHISTLER MODE SATELLITE-TO-GROUND Report for Mar. 1970 - Mar. 1971**
Robert B. Dybdal 20 Dec. 1971 75 p refs
(Contract F04701-71-C-0172)
(AD-736429; TR-0172(2310)-1; SAMSO-TR-71-314) Avail: NTIS CSCL 17/2

The properties of a satellite-to-ground whistler mode communication link are discussed. The propagation mechanisms of a whistler mode link are examined, present knowledge concerning the performance of spaceborne transmitting ELF/VLF antennas is summarized, and implications for communication system are considered. The two major unknowns in the whistler mode communication link are the performance of a transmitting spaceborne ELF/VLF antenna, and the coupling of whistler mode energy through the ionosphere into the terrestrial waveguide. An experimental program to establish link performance is recommended. Author (GRA)

**N72-21195#** General Motors Corp., Goleta, Calif. Delco Electronics Div.
**REMOTE AUTOMATIC MULTIPURPOSE STATION**
Jan. 1972 11 p
(Contract N00014-71-C-0357; ARPA Order 1783)
(AD-736221; TR-2) Avail: NTIS CSCL 09/6

The RAMS field test system consisted of the following: an ESK, SSB modulator capable of operation in the three selected bands of 4 to 5 mHz, 6 to 7 mHz and 8 to 9 mHz; a broadband 100 watt, solid state power amplifier; an antenna coupling network; a DDRR antenna; an Accurton timer; and a propane powered motor generator. The thermoelectric cell power source was also installed at the field test site. The initial tests were encouraging and the RAMS signal was received at T3 approximately 1100 nautical miles away. Author (GRA)

**N72-21196#** Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
**A TELEVISION DATA SYSTEM**
J. J. Poetker Apr. 1971 73 p
(Contract N00017-62-C-0604)
(AD-736150; APL-TG-1157) Avail: NTIS CSCL 17/2

A television data system designed by the Applied Physics Laboratory provides a data gathering and reduction system for use in the Anti-Ship Program, Project Harpoon. The system is installed in an aircraft test bed that simulates the flight path of a guided missile. The data are returned to the Laboratory for analysis to provide information concerning hit probability, miss distance, track noise, and seeker performance. The systems elsctronic circuitry design and performance are described. Author (GRA)

**N72-21294#** European Space Research and Technology Center, Noordwijk (Netherlands).
**COHERENT DETECTION METHODS FOR SPACE COMMUNICATION**
R. W. Okkes *In* ESRO Spacecraft Operations, vol. 1 Apr. 1971 p 39-50 (See N72-21291 12-11)
Avail: NTIS

**N72-21295#** European Space Research and Technology Center, Noordwijk (Netherlands).
**DATA GENERATION ON BOARD SATELLITES [GENERATION DES DONNEES A BORD DES SATELLITES]**
J. Toussaint *In* ESRO Space Operations, vol. 1 Apr. 1971 p 53-65 In FRENCH (See N72-21291 12-11)
Avail: NTIS

**N72-21299#** European Space Operations Center, Darmstadt (West Germany).
**CONTROL OF SPACECRAFT DURING THEIR LIFE TIME [LE CONTROLE DES VEHICULES SPATIAUX DURANT LEUR VIE UTILE]**
G. Valentiny *In* ESRO Spacecraft Operations Jun. 1971 p 31-50 In FRENCH (See N72-21296 12-11)
Avail: NTIS

# 08 COMPUTERS

Includes computer operation and programming; and data processing. For applications, see specific categories. For related information see also: 19 Mathematics.

**N72-21197*** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
**HIGH SPEED DIRECT BINARY-TO-BINARY CODED DECIMAL CONVERTER Patent**
Pierce C. Toole, inventor (to NASA) Issued 25 Jan. 1972 9 p Filed 3 Apr. 1970 Supersedes N70-35414 (08 - 22, p 3568)
(NASA-Case-KSC-10326; US-Patent-3,638,002;
US-Patent-Appl-SN-25487; US-Patent-Class-235-155;
US-Patent-Class-340-347DD) Avail: US Patent Office CSCL 09B

A binary-to-binary coded decimal converter is described that can be readily expanded to handle numbers of any magnitude. The converter consists of numerous decades connected in cascade with a carry circuit between each decade. The carry circuit supplies carry numbers to the succeding decade and sends a corrector number back to a corrector circuit associated with the preceding decade. The corrector number is then

combined with binary numbers already stored in the corrector circuit to produce a signal on an associated readout device.
Official Gazette of the U.S. Patent Office

N72-21198* National Aeronautics and Space Administration, Washington, D.C.
**SEMICONDUCTOR-FERROELECTRIC MEMORY DEVICE** Patent
David E. Sawyer, inventor (to NASA) Issued 23 Nov. 1971 6 p Filed 22 May 1970 Supersedes N70-35579 (08 - 19, p 3508)
(NASA-Case-ERC-10307; US-Patent-3,623,030; US-Patent-Appl-SN-39755; US-Patent-Class-340-173.2; US-Patent-Class-340-173LS; US-Patent-Class-307-299; US-Patent-Class-307-303; US-Patent-Class-307-311) Avail: US Patent Office CSCL 09B

A monolithic, optically written and electrically read ferroelectric memory element employing a single crystal of barium titanate is described. One portion of the crystal possesses ferroelectric capacitor properties and another portion has been reduced to convert that portion from an insulator material to an N-type semiconductor. At least one of the capacitor electrodes is transparent and contacts the semiconductor portion to form a Schottky barrier electrode. With the memory element connected in a circuit such that the Schottky diode is reverse biased, the write state is achieved by light excitation of the semiconductor portion through the transparent electrode which charges the ferroelectric capacitor portion of the crystal. The device is electrically read by examining the remanent polarization state of the ferroelectric capacitor portion.
Official Gazette of the U.S. Patent Office

N72-21199* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**CURRENT STEERING COMMUTATOR** Patent
Russell K. Caplette, inventor (to NASA) Issued 12 Oct. 1971 7 p Filed 15 Aug. 1969 Supersedes N70-34698 (08 - 18, p 3321) Sponsored by NASA
(NASA-Case-NPO-10743; US-Patent-3,613,110; US-Patent-Appl-SN-850587; US-Patent-Class-340-174SR; US-Patent-Class-340-174CS; US-Patent-Class-340-174LC; US-Patent-Class-340-174M) Avail: US Patent Office CSCL 09B

A commutator is described for steering a controlled current successively through numerous loads. The commutator employs a two-phase magnetic core shift register comprised of a number of stages, each stage including a transmit core and a receive core. The number of loads equals the sum of the transmit and receive cores where unidirectional load currents are required. Where bidirectional load currents are required, a transmit core and a receive core are dedicated to each load. The cores are interconnected so as to shift a binary '1' (set state) from a stage transmit core to the receive core of the same stage during a first phase and then to the transmit core of the following stage during a second phase. Core drive pulses are alternately applied to all of the transmit and receive cores.
Official Gazette of the U.S. Patent Office

N72-21200* TRW Systems Group, Redondo Beach, Calif.
**WIDE RANGE ANALOG-TO-DIGITAL CONVERTER WITH A VARIABLE GAIN AMPLIFIER** Patent
Larry W. Moede, inventor (to NASA) Issued 12 Oct. 1971 8 p Filed 3 Nov. 1969 Supersedes N70-20693 (08 - 08, p 1412) Sponsored by NASA
(NASA-Case-NPO-11018; US-Patent-3,613,111; US-Patent-Appl-SN-873259; US-Patent-Class-340-347AD) Avail: US Patent Office CSCL 09B

An analog to digital converter is described which is designed to respond to a wide range to amplitudes of analog input signals. The output of the amplifier is supplied to a number of comparators, each one comparing the amplifier output with respect to a different threshold level and providing a true output which affects the amplifiers's gain. The combined outputs of the comparators represents the converter's output digital representation.
Official Gazette of the U.S. Patent Office

N72-21201*# M&S Computing, Inc., Huntsville, Ala.
**FLIGHT PROGRAM LANGUAGE REQUIREMENTS. VOLUME 3: APPENDICES**
7 Mar. 1972 262 p
(Contract NAS8-26990)
(NASA-CR-123569; Rept-72-0005-Vol-3) Avail: NTIS CSCL 09B

Government-sponsored study and development efforts were directed toward design and implementation of high level programming languages suitable for future aerospace applications. The study centered around an evaluation of the four most pertinent existing aerospace languages. Evaluation criteria were established, and selected kernels from the current Saturn 5 and Skylab flight programs were used as benchmark problems for sample coding. An independent review of the language specifications incorporated anticipated future programming requirements into the evaluation. A set of language requirements was synthesized from these activities.
Author

N72-21202*# Computer Sciences Corp., Huntsville, Ala. Field Services Div.
**COMPUTER SYSTEM SIMULATION AND ANALYSIS**
T. G. Williams and J. E. Weatherbee 6 Mar. 1972 22 p refs
(Contract NAS8-21805)
(NASA-CR-61376) Avail: NTIS CSCL 09B

A simulation model has been developed as a tool for studying different computer system configurations. The model simulates a computer system in terms of the number and speed of hardware subsystems and the runs processed by the system in terms of equivalent adds for computation and data bits transferred for I/O. The model was written in the GPSS simulation language.
Author

N72-21203*# Intermetrics, Inc., Cambridge, Mass.
**ADVANCED SOFTWARE TECHNIQUES FOR DATA MANAGEMENT SYSTEMS. VOLUME 3: PROGRAMMING LANGUAGE CHARACTERISTICS AND COMPARISON REFERENCE** Final Report
T. A. James, B. C. Hall, and P. M. Newbold Feb. 1972 288 p
(Contract NAS9-11778)
(NASA-CR-115515) Avail: NTIS CSCL 09B

A comparative evaluation was made of eight higher order languages of general interest in the aerospace field: PL/1; HAL; JOVIAL/J3; SPL/J6; CLASP; ALGOL 60; FORTRAN 4; and MAC360. A summary of the functional requirements for a language for general use in manned aerodynamic applications is presented. The evaluation supplies background material to be used in assessing the worth of each language for some particular application.
A.L.

N72-21204*# Intermetrics, Inc., Cambridge, Mass.
**ADVANCED SOFTWARE TECHNIQUES FOR DATA MANAGEMENT SYSTEMS. VOLUME 1: STUDY OF SOFTWARE ASPECTS OF THE PHASE B SPACE SHUTTLE AVIONICS SYSTEM** Final Report, 16 Jun. 1971 - 1 Feb. 1972
Fred H. Martin Feb. 1972 263 p refs
(Contract NAS9-11778)
(NASA-CR-115513; TR-12-72-Vol-1) Avail: NTIS CSCL 09B

An overview of the executive system design task is presented. The flight software executive system, software verification, phase B baseline avionics system review, higher order languages and compilers, and computer hardware features are also discussed.
J.A.M.

N72-21205*# Intermetrics, Inc., Cambridge, Mass.
**ADVANCED SOFTWARE TECHNIQUES FOR DATA MANAGEMENT SYSTEMS. VOLUME 2: SPACE SHUTTLE FLIGHT EXECUTIVE SYSTEM: FUNCTIONAL DESIGN** Final Report, 16 Jun. 1971 - 16 Feb. 1972
James T. Pepe Feb. 1972 187 p refs
(Contract NAS9-11778)

(NASA-CR-115514; TR-12-72-Vol-2) Avail: NTIS CSCL 09B

A functional design of software executive system for the space shuttle avionics computer is presented. Three primary functions of the executive are emphasized in the design: task management, I/O management, and configuration management. The executive system organization is based on the applications software and configuration requirements established during the Phase B definition of the Space Shuttle program. Although the primary features of the executive system architecture were derived from Phase B requirements, it was specified for implementation with the IBM 4 Pi EP aerospace computer and is expected to be incorporated into a breadboard data management computer system at NASA Manned Spacecraft Center's Information system division. The executive system was structured for internal operation on the IBM 4 Pi EP system with its external configuration and applications software assumed to the characteristic of the centralized quad-redundant avionics systems defined in Phase B. Author

N72-21206*# Autonetics, Anaheim, Calif.

**AN ADAPTIVE VOTING COMPUTER SYSTEM Patent Application**

Louis J. Koczela and Donald S. Wilgus, inventors (to NASA) Filed 25 Feb. 1972 93 p

(Contract NAS9-10416)

(NASA-Case-MSC-13932-1; US-Patent-Appl-SN-229354) Avail: NTIS CSCL 09B

A computer system is described which uses adaptive voting to tolerate failures and operate in a fail-operational, fail-safe manner. Each of four computers is individually connected to one of four external input/output busses which interface with external subsystems. Each computer is connected to receive input data and commands from the other three computers and to furnish output data and commands to them. An adaptive control apparatus including a voter comparator switch is provided for each computer to receive signals from each of the computers and permits adaptive voting among the computers. NASA

N72-21207*# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.

**A MODEL FOR PROCESS REPRESENTATION AND SYNTHESIS Ph.D. Thesis**

Robert H. Thomas Jun. 1971 268 p refs Sponsored in part by ARPA

(Grant NGR-22-009-393; Contract Nonr-4102(01); Proj. MAC)

(NASA-CR-122379; MAC-TR-87) Avail: NTIS CSCL 09B

The problem of representing groups of loosely connected processes is investigated, and a model for process representation useful for synthesizing complex patterns of process behavior is developed. There are three parts, the first part isolates the concepts which form the basis for the process representation model by focusing on questions such as: What is a process; What is an event; Should one process be able to restrict the capabilities of another? The second part develops a model for process representation which captures the concepts and intuitions developed in the first part. The model presented is able to describe both the internal structure of individual processes and the interface structure between interacting processes. Much of the model's descriptive power derives from its use of the notion of process state as a vehicle for relating the internal and external aspects of process behavior. The third part demonstrates by example that the model for process representation is a useful one for synthesizing process behavior patterns. In it the model is used to define a variety of interesting process behavior patterns. The dissertation closes by suggesting how the model could be used as a semantic base for a very potent language extension facility. Author

N72-21208*# System Development Corp., Santa Monica, Calif.

**AN ON-LINE SYSTEM FOR HAND-PRINTED INPUT Final Report**

T. G. Williams and Joan Bebb 30 Aug. 1971 44 p refs

(Contracts NAS12-526; DAHC15-67-C-0149)

(NASA-CR-126036; SDC-TM-4786/000/00) Avail: NTIS CSCL 09B

The capability of graphic input/output systems is described. Topics considered are a character recognizer and dictionary building program, an initial flow chart element input program, and a system entitled The Assistant Mathematician, which uses ordinary mathematics to specify numeric computation. All three parts are necessary to allow a user to carry on a mathematical dialogue with the computer in the language and notation of his discipline or problem domain. Author

N72-21209*# National Aeronautics and Space Administration, Washington, D.C.

**DIGITAL CIRCUITS FOR COMPUTER APPLICATIONS: A COMPILATION Technology Utilization**

[1972] 24 p

(NASA-SP-5949(01)) Avail: NTIS HC $1.00/MF $0.95 CSCL 09B

The innovations in this updated series of compilations dealing with electronic technology represent a carefully selected collection of digital circuits which have direct application in computer oriented systems. In general, the circuits have been selected as representative items of each section and have been included on their merits of having universal applications in digital computers and digital data processing systems. As such, they should have wide appeal to the professional engineer and scientist who encounter the fundamentals of digital techniques in their daily activities. The circuits are grouped as digital logic circuits, analog to digital converters, and counters and shift registers. Author

N72-21210*# Connecticut Univ., Storrs. Research Applications Center.

**USING A SMALL/LOW COST COMPUTER IN AN INFORMATION CENTER**

Daniel U. Wilde [1972] 12 p refs

(Contract NASw-2307)

(NASA-CR-126039) Avail: NTIS CSCL 09B

Small/low cost computers are available with I/O capacities that make them suitable for SDI and retrospective searching on any of the many commercially available data bases. A small two-tape computer system is assumed, and an analysis of its run-time equations leads to a three-step search procedure. Run times and costs are shown as a function of file size, number of search terms, and input transmission rates. Actual examples verify that it is economically feasible for an information center to consider its own small, dedicated computer system. Author

N72-21211# Advisory Group for Aerospace Research and Development, Paris (France).

**COMPUTERS IN THE GUIDANCE AND CONTROL OF AEROSPACE VEHICLES**

C. T. Leondes, ed. (Calif. Univ., Los Angeles) Feb. 1972 265 p refs

(AGARDograph-158; AGARD-AG-158) Avail: NTIS

The utilization of computer technology in aerospace systems is examined in detail. Three major areas are considered; (1) system design techniques, (2) systems hardware techniques, and (3) guidance and control computer systems applications. For individual titles, see N72-21212 through N72-21227.

N72-21212# North American Rockwell Corp., Anaheim, Calif.

**OVERVIEW OF AEROSPACE VEHICLE COMPUTER APPLICATIONS**

Gordon H. Smith *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb. 1972 p 1-7 (See N72-21211 12-08)

Avail: NTIS

A brief historical treatment is presented of the application of digital computing techniques to aerospace systems. The technological developments in both hardware and system application are summarized and the impact of new technologies

is discussed. Problems which have developed in applying digital computers in real time control systems are identified along with successful solutions to those problems. Author

**N72-21213#** International Business Machines Corp., Owego, N.Y. Electronics Systems Center.
**FEDERATED VS INTEGRATED COMPUTER SYSTEMS**
James H. Crenshaw *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb. 1972 p 9-22 refs (See N72-21211 12-08)
Avail: NTIS

The computer system organizations utilized in current aerospace systems and design considerations for developmental systems are reviewed. The advantages and disadvantages of the federated and integrated approaches are analyzed and the system dependent variables which must be considered by the designer are discussed to emphasize the real world situation. Features such as vulnerability to battle damage and graceful degradation are considered along with the queuing theory, waiting time, and loading factor. Author

**N72-21214#** Teledyne Systems Co., Northridge, Calif.
**GUIDANCE AND CONTROL COMPUTER SYSTEM DESIGN**
Earl Kanter *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb. 1972 p 23-43 (See N72-21211 12-08)
Avail: NTIS

The subject of logical organization of typical aerospace computers is considered from the standpoint of integrated circuit technology and architectual requirements. First a proposed circuit technology amenable to a flexible mechanization of modern architecture is presented. Then, two general classes of computer systems design are discussed, utilizing this circuit technology. The two general classes are represented by a special purpose guidance and control computer and a general purpose computer programmable for a guidance and control application. Author

**N72-21215#** North American Rockwell Corp., Downey, Calif.
**REAL TIME PROGRAMS FOR AEROSPACE VEHICLES**
Victor Strand and L. J. Andrews (IBM Corp., Huntsville, Ala.) *In* AGARD Computers in the guidance and control of Aerospace Vehicles Feb. 1972 p 45-56 (See N72-21211 12-08)
Avail: NTIS

An overview is presented of the developmental and technical considerations associated with the generation and checkout of computer programs for real time control of aerospace vehicles. Technical topics include a discussion of executive programs, program growth, program modularity, fixed vs. floating point arithmetic, higher order languages, etc. The software preliminary and baseline designs, documentation, verification, validation, models, monitors and program management are discussed as they affect the production and checkout of real time aerospace software. A brief dissertation on future efforts and considerations is also presented. Author

**N72-21216#** Singer-Librascope, Glendale, Calif.
**PROGRAMMING CHARACTERISTICS OF FUTURE G AND C COMPUTERS**
Austin J. Maher *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb. 1972 p 57-63 refs (See N72-21211 12-08)
Avail: NTIS

The types of difficulties encountered in developing and maintaining airborne computer programs are reviewed. These include problems encountered in the initial development of the system program and the significant changes to the original program based on laboratory and flight tests of the over-all system. By assimilating results of previous system development experience and predicting the trends in airborne computer hardware development, characteristics are proposed for future airborne Guidance and Control computers. The proposed computer characteristics would minimize significant programming difficulties while retaining desirable hardware features (e.g., protected memory, small size, etc.). The features covered include word length tradeoffs, type of arithmetic, addressing techniques, subprogram linkages, etc., and in summary represent a functional specification for a class of future airborne computers using MSI or LSI techniques. Finally, the specific characteristics are presented of an airborne computer designed to meet these functional specifications. Author

**N72-21217#** International Business Machines Corp., Owego, N.Y. Electronics Systems Center.
**AEROSPACE COMPUTER WORD LENGTH CONSIDERATIONS**
G. W. Braudaway and C. J. Standish *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb. 1972 p 65-71 refs (See N72-21211 12-08)
Avail: NTIS

A number of data word and instruction format factors are described which must be considered when selecting the length(s) of instructions and data words to be implemented in an aerospace computer. The primary emphasis is on selection of data-word and instruction lengths under the constraint that data and instruction lengths are compatible. This is, the data-word length is an integral multiple of the instruction word length. This implementation is appropriate when data and instructions are to be stored in the same area of memory. In a section devoted to storage efficiency, the effects on implementation of removing this compatibility constraint are examined. Examples drawn from avionic navigation computations are used to illustrate the premise that variable word length arithmetic can be used to produce numeric results equivalent to those produced by uniform word length arithmetic while reducing storage requirements substantially. Additional storage savings can result from use of variable length instruction formats. The need is demonstrated for continued development of programming techniques for utilizing variable word length arithmetic and instruction formats efficiently. Author

**N72-21218#** Sperry Rand Corp., St. Paul, Minn. Univac Div.
**AEROSPACE COMPUTER MEMORY TECHNIQUES**
J. R. Erhardt, K. L. Pearson, W. S. Makos, and E. J. Torok *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb. 1972 p 73-82 refs (See N72-21211 12-08)
Avail: NTIS

Current avionics and aerospace memory technology are described, and the techniques available in today's production systems as well as those soon likely to be in production are reviewed. Three major categories are discussed: magnetic memories, semiconductor memories and mass memory applications of plated wire, and thin film and domain wall propagation techniques. Author

**N72-21219#** Teledyne Systems Co., Northridge, Calif.
**AEROSPACE COMPUTER INPUT-OUTPUT TECHNIQUES**
P. K. Hammond and W. T. Palmer *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb. 1972 p 83-91 (See N72-21211 12-08)
Avail: NTIS

The design philosophy applied to the interfacing elements of an aerospace computer is discussed in terms of establishing the overall performance, reliability, maintainability, and cost of the system. Most of the key functional requirements which should be considered in the design phase of interfacing equipment are reviewed. Author

**N72-21220#** Bendix Corp., Teterboro, N.J. Navigation and Control Div.
**FAULT ISOLATION IN A DIGITAL GUIDANCE AND CONTROL COMPUTER**
David H. Blauvelt *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb. 1972 p 93-98 (See N72-21211 12-08)

Avail: NTIS

The possibility is examined of a general purpose digital computer being able to realize an optimum fault isolation capability in a guidance and control application. It is shown that if proper attention is given to the functional partitioning of the computer, self-test and self-diagnostic programs can be written which will determine that faults have occurred and will isolate them to the replaceable card level. It is also demonstrated that this can be accomplished with virtually no additional flight hardware and a relatively simple test console which allows maintenance personnel to communicate with the computer in question. Author

**N72-21221#** Hughes Aircraft Co., Culver City, Calif. Aerospace Group.

**GUIDANCE AND CONTROL COMPUTER ACTUATED DISPLAY SYSTEM TECHNIQUES**

G. K. Slocum, J. W. Gunvordahl, M. Weihrauch, and J. W. Weber *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb. 1972 p 99-115 ref (See N72-21211 12-08)

Avail: NTIS

The airborne computer is discussed in its relationship to the display systems it drives, and to the part that the crew plays in the management and control processes. These relationships are considered for current and near-term tactical aircraft systems with an outlook to the possibilities for the future. Author

**N72-21222#** Teldix Luftfahrt-Ausruestungs G.m.b.H., Heidelberg (West Germany).

**SYSTEMS TASKS FOR ADVANCED AIRCRAFT NAVIGATION SYSTEMS** c21

F. G. Unger and R. S. Sindlinger *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb. 1972 p 117-130 refs (See N72-21211 12-08)

Avail: NTIS

Conventional navigation systems are described and compared with advanced systems proposed for military aircraft with instrumentation that would include: an inertial platform; a Doppler radar; means for position fixing; and back-up devices such as air data units, magnetic compasses, etc. The additional tasks that would then be required of the navigation computer and data processing equipment are summarized. Possible hardware solutions are outlined and approaches to developing optimal equipment configurations are examined. K.L.G.

**N72-21223#** Teledyne Systems Co., Northridge, Calif.

**HELICOPTER GUIDANCE AND CONTROL COMPUTER SYSTEMS**

Lawrence A. Kaufman *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb. 1972 p 131-155 (See N72-21211 12-08)

Avail: NTIS

The use of central digital computers for helicopter avionic system functions is examined and it is shown how the use of such techniques has evolved as a consequence of the application of helicopters in increasingly more complex missions. The first of these new helicopter digital systems to be developed, the U.S. Marine Corps Integrated Helicopter Avionic System (IHAS), is described in terms of the conceptual design approaches used. The system syntheses problems which are experienced using digital computation techniques are analyzed. Future trends for the application of central digital computers for both helicopters and VTOL aircraft are indicated. Author

**N72-21224#** Litton Systems, Inc., Woodland Hills, Calif. Guidance and Control Systems Div.

**INTEGRATED INERTIAL DOPPLER LORAN COMPUTER GUIDANCE AND CONTROL**

Robert G. Berfield and William O. Felsman *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb. 1972 p 157-174 (See N72-21211 12-08)

Avail: NTIS

The navigation/guidance computer requirements for a typical, integrated inertial-Doppler-loran mechanization are outlined, and the techniques are described for generating an efficient and accurate operational program. Author

**N72-21225#** ITT Avionics, Nutley, N.J.

**COMPUTERS FOR LORAN C/D AND OMEGA NAVIGATION AND GUIDANCE SYSTEMS**

James P. VanEtten and Gerald P. Zemlin *In* AGARD Computers in the Guidance Control of Aerospace Vehicles Feb. 1972 p 175-228 refs (See N72-21211 12-08)

Avail: NTIS

A synopsis is given of geometry fundamentals pertinent to position-accuracy assessment, the fundamentals of both the loran C/D and Omega systems (including technical summaries of low-frequency and very-low-frequency propagation), and the general effects of vehicle dynamics on system implementation. The application of the modern airborne digital computer to radio navigation signal processing tasks such as signal acquisition and signal tracking is described for both loran C/D and Omega, using advanced radio navigation sensor design approaches as a basis. The more common application of computers to the task of converting from hyperbolic radio coordinates to geographic coordinates of latitude and longitude, and from these to UTM northing and easting, is treated, and the problems entailed in correcting these geographic coordinates for variations in radio propagation are also addressed. Simplified techniques for application of hyperbolic radio navigation data to guidance functions are discussed. Finally, the implications of loran C/D and Omega processing tasks toward establishment of efficient architecture for airborne computers, are discussed, and short tables of desired instructions listed in order of importance are presented. Author

**N72-21226#** TRW Systems Group, Redondo Beach, Calif. Guidance and Navigation Lab.

**COMPUTERS FOR SATELLITE BASED NAVIGATION AND GUIDANCE SYSTEMS**

T. L. Rodrick and T. I. Fine *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb. 1972 p 229-245 refs (See N72-21211 12-08)

Avail: NTIS

The considerations involved in selecting a computer for an airborne navigation satellite user are examined. The software is described which will be used by navigation satellite users and which determines the user's computer requirements. The navigation satellite systems which are treated, are ranging or range differencing systems in which the user is passive (does not transmit to the satellite). The software is described in modular fashion to illustrate how a variety of user needs can be satisfied by different combinations of the same modular components. A description of the Kalman filter design considerations for a combined navigation satellite/inertial system is included which shows how computer speed and memory requirements depend upon the filter state vector size. Author

**N72-21227#** International Business Machines Corp., Owego, N.Y. Electronics Systems Center.

**COMPUTERS FOR THE GUIDANCE AND CONTROL OF TACTICAL AIRCRAFT**

W. J. Bernhart *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb. 1972 p 247-268 (See N72-21211 12-08)

Avail: NTIS

The navigational and guidance function provided a typical tactical application by utilization of a digital computer mechanization is analyzed. A brief description is given of the methods utilized to accomplish these functions and the sensors utilized in displaying pilot information and system configuration. The capabilities afforded the tactical vehicle by using digital devices for computation of navigational and guidance algorithms are summarized. Author

**N72-21228#** Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.
**MIMUSA: A FORTRAN 4 SUBROUTINE FOR UNFOLDING SPECTRA. PART 1: THEORY, DISCUSSION AND RESULTS**
J. P. Longworth May 1971 42 p refs
(RD/B/N-1962-Pt-1) Avail: AEC Depository Libraries

MIMUSA (matrix iteration method of unfolding spectra) unfolds spectra in two stages. In the first stage, an error function is minimized using a modified form of Gold's iterative matrix multiplication method. In the second stage, the error function is further reduced by varying the spectral groups cyclically, using an addition method. The two main sources of uncertainty in the final spectrum are the errors in the experimental data and those in the unfolding procedure; MIMUSA calculates these effects independently. The theory is described and the results obtained with MIMUSA, using several types of response matrix, are discussed with special reference to results obtained with the DELTA neutron spectrometer. Author (NSA)

**N72-21229#** Aerophysics Research Corp., Bellevue, Wash.
**COMBAT OPTIMIZATION AND ANALYSIS PROGRAM (COAP). VOLUME 1: PROBLEM FORMULATION Final Report, Sep. 1969 - Dec. 1970**
D. S. Hague, R. T. Jones, and C. R. Glatt Wright-Patterson AFB, Ohio AFFDL May 1971 302 p refs
(Contract F33615-70-C-1036; AF Proj. 1431)
(AD-734755; AFFDL-TR-71-52-Vol-1) Avail: NTIS CSCL 09/2

COAP is a program for the simulation and optimization of combative and cooperative two-vehicles flight paths. It includes single vehicle flight path problem capability as a subcase. Considerable emphasis is placed on the use of modern optimization. The program has the ability to perform trajectory optimization by the variational steepest-descent method including search for optimal initial conditions; search for optimal arch (stage) lengths; constraints defined at terminal point, intermediate corners (stage points), or along the path and optimum parameter (design variable) values. The program can solve two system (vehicle) problems with or without reacting feedback from the second system (vehicle). Author (GRA)

**N72-21230#** New Mexico Univ., Albuquerque. Bureau of Engineering Research.
**CAFA: A COMPUTER AIDED CURVE-FIT AND ANALYSIS PROGRAM**
Bruce W. Noel Sep. 1971 42 p refs
(Contract N00014-68-A-0158)
(AD-735946; EE-187(71)ONR-005) Avail: NTIS CSCL 09/2

The theoretical basis for the CAFA program is discussed. An approximate technique evolving from the theory is applied to the analysis of the current-voltage characteristic of a hypothetical diode, with good results. A printout of the resultant program and data is included. Author (GRA)

**N72-21231#** Army Electronics Command, Fort Monmouth, N.J.
**IHAS-4 SOFTWARE REPORT**
M. J. Fisher, C. Galanti, and D. Haddon Dec. 1971 36 p
(DA-Proj. 1F1-62202-AA-91)
(AD-765681; ECOM-3516) Avail: NTIS CSCL 09/2

A brief description is given of a complementary software package developed for in-house use of the IHAS-4 computer. The package insists of a basic two-pass assembler and a simulator that stimulates the computer to a functional level. Author (GRA)

**N72-21232#** Illinois Univ., Urbana. Coordinated Science Lab.
**TWO COMPUTER ALGORITHMS FOR OBTAINING THE PERIODIC RESPONSE OF NONLINEAR CIRCUITS Ph.D. Thesis**
Thomas Joseph Aprille, Jr. Dec. 1971 95 p refs
(Contract DAAB07-67-C-0199; Grant NSF GK-31633)
(AD-735713; R-540; UILU-ENG-71-2243) Avail: NTIS CSCL 09/5

In the computer-aided analysis of a nonlinear circuit with a stable periodic response, the steady state periodic response is usually found for a given initial state by simply integrating the system equations until the response becomes periodic. In a lightly damped system this integration could extend over many periods making the computation costly. In the paper two Newton algorithms are defined. The first algorithm is for the steady state analysis of nonautonomous systems and the second algorithm is for the steady state analysis of autonomous systems. The algorithms are applied to several nonlinear circuits. The results show a considerable reduction in the amount of time necessary to compute the steady state response. In addition, the initial iterates give information on the transient response of the system. Author (GRA)

**N72-21233#** Georgia Univ., Athens. Dept. of Statistics and Computer Science.
**INTERACTIVE QUANTAL ANALYSIS**
Judith H. Ishee and Rolf Bargmann Sep. 1971 134 p refs
(Contract N00014-69-A-0423; NR Proj. 042-261; Proj. Themis)
(AD-735145; TR-74; THEMIS-UGA-16) Avail: NTIS CSCL 09/2

The report describes development and implementation of a conversational computer program for the statistical analysis of biological assays and related quantal data. The program is designed for use by scientists who need not possess more than an elementary knowledge of statistics or computation. A graphics console (CRT display, typewriter, function keyboard) serves as the medium of conversation. Questions are displayed to the user. On the basis of data supplied by him, the appropriate analysis is performed and results are displayed graphically and numerically. Author (GRA)

**N72-21234#** Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group.
**SECURITY OF THE TACC DATA BASE STUDY (DESCRIPTION OF AUTOMATIC DATA BASE SECURITY TECHNIQUES)**
Bedford, Mass. ESD Sep. 1970 152 p refs 5 Vol.
(Contract F19628-70-C-0185)
(AD-735728; ESD-TR-71-370-Vol-1) Avail: NTIS CSCL 09/2

The report presents the results of a study which surveyed the various aspects of system security hardware, software and procedural techniques in use in current and proposed automated systems. Thirty-four systems were considered, including 20 government and 14 commercial systems. The security requirements, system environment and function, and techniques employed are described for each system. A total of 95 techniques are identified, of which 41 are software, 34 are hardware, and 20 are procedural techniques. The total number of techniques found as a result of this survey is a considerably larger number than known to exist prior to initiation of the survey. Some quantitative data detailing the relative costs involved in developing, using, and maintaining these techniques was obtained and is provided in this report. Qualitative estimates of cost are made in the remaining cases. An initial approach to categorizing systems by their security requirements and categorizing techniques by their application to security requirements was devised and applied to the raw data obtained from the survey. Author (GRA)

**N72-21235#** Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group.
**ANALYSIS OF DATA BASE SECURITY AND ACCESS LIMITATION REQUIREMENTS FOR THE POST 1975 AUTOMATED TACC COMPLEX: TABULATION OF TACC SECURE DATA**
Bedford, Mass. ESD Oct. 1971 356 p refs 5 Vol.
(Contract F19628-70-C-0185)
(AD-735729; ESD-TR-71-370-Vol-2) Avail: NTIS HC $6.00/MF $0.95 CSCL 09/2

The purpose of this study titled "Analysis of Data Base

Security and Access Limitation Requirements for the Post-1975 Automated TACC Complex" is to establish a TACC data base baseline from which a clear understanding of security and access requirements can be obtained. Author (GRA)

**N72-21236#** Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group
**ANALYSIS OF DATA BASE SECURITY AND ACCESS LIMITATION REQUIREMENTS FOR THE POST 1975 AUTOMATED TACC COMPLEX: ANALYSIS OF TACC SECURE DATA**
Bedford, Mass. ESD Oct. 1971 203 p 5 Vol.
(Contract F19628-70-C-0185)
(AD-735730; ESD-TR-71-370-Vol-3) Avail: NTIS CSCL 09/2

The Analysis of the Data Base Security and Access Limitation Requirements for the post-1975 Automated TACC Complex was conducted to provide the United States Air Force and other military agencies with detailed information concerning (a) current and completed studies which have addressed the security and access limitation problems and methods of implementation for automated information systems; (b) the determination and structuring of a TACC data base baseline; and (c) the identification of the users of TACC data and their access requirements to classified portions of the TACC data base. The data developed were to be used both in the development of incremental growth capabilities in the TACC and in the design of future automation of the TACS. Author (GRA)

**N72-21237#** Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group.
**ANALYSIS OF DATA BASE SECURITY AND ACCESS LIMITATION REQUIREMENTS FOR THE POST 1975 AUTOMATED TACC COMPLEX: TABULATION OF TACC SECURE DATA ACCESSES**
Bedford, Mass. ESD Oct. 1971 367 p refs 5 Vol.
(Contract F19628-70-C-0185)
(AD-735731; ESD-TR-71-370-Vol-4) Avail: NTIS HC$6.00/MF $0.95 CSCL 09/2

Characteristics of data users in the TACC data base are tabulated. An explanation of terms and a list of acronyms and abbreviations are also presented. Author

**N72-21238#** Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group
**ANALYSIS OF DATA BASE SECURITY AND ACCESS LIMITATION REQUIREMENTS FOR THE POST 1975 AUTOMATED TACC COMPLEX: ANALYSIS OF TACC SECURE DATA ACCESSES**
Bedford, Mass. ESD Oct. 1971 93 p
(Contract F19628-70-C-0185)
(AD-735732; ESD-TR-71-370-Vol-5) Avail: NTIS CSCL 09/2

The Analysis of Data Base Security and Access Limitation Requirements for the post-1975 Automated TACC Complex was conducted to provide the United States Air Force and other military agencies with detailed information concerning (a) current and completed studies which have addressed the security and access limitation problems and methods of implementation for automated information systems; (b) the determination of a TACC data base baseline; and (c) the identification of the users of TACC data and their access requirements to classified portions of the TACC data base. The data developed were to be used both in the development of incremental growth capabilities in the TACC and in the design of future automation of the TACS. Author (GRA)

**N72-21239#** Aerophysics Research Corp., Bellevue, Wash.
**COMBAT OPTIMIZATION AND ANALYSIS PROGRAM (COAP). VOLUME 3: PROGRAMMER'S MANUAL Final Report, Sep. 1969 - Dec. 1970**
D. S. Hague, R. T. Jones, and C. R. Glatt Apr. 1971 504 p refs
(Contract F33615-70-C-1036; AF Proj. 1431)
(AD-735293; AFFDL-TR-71-52-Vol-3) Avail: NTIS HC$6.00/MF $0.95 CSCL 09/2

The report describes a generalized digital computer program for the simulation and/or optimization of arbitrarily defined vehicle flight paths. Two simultaneously coupled three-dimensional point mass trajectories about a rotating oblate planet having a multi-layered atmosphere may be employed. Levels of reduced complexity varying from the generalized problem to straightforward planar point mass, single vehicle, vacuum trajectories may be studied with the aid of the program. Author (GRA)

**N72-21240#** Illinois Univ., Urbana. Coordinated Science Lab.
**HIGH DENSITY OPTICAL MEMORY Quarterly Progress Report, Oct. - Dec. 1971**
H. W. Knoebel and H. V. Krone Jan. 1972 6 p
(Contract N00014-67-A-0305-0015)
(AD-735903) Avail: NTIS CSCL 09/2

During the consideration of the design parameters of an acousto-optic laser beam deflection system, it became apparent that scattered light from the deflection system, and other sources, could be a factor in limiting the size of the color center memory system. This would be particularly true if low-level scattered light is capable of rotating the M(A) color centers with the same efficiency as high intensity light. Work during this quarter has been directed toward obtaining this data for M(A) centers in potassium chloride. Author (GRA)

**N72-21241#** Rome Air Development Center, Griffiss AFB, N.Y.
**WAVEFORM PROCESSING SYSTEM (WPS)**
Donald H. Foley, Haywood E. Webb, Jr., Albert H. Proctor, and John C. Faust Nov. 1971 61 p refs
(AD-735749; RADC-TR-71-235) Avail: NTIS CSCL 09/2

The Waveform Processing System (WPS) is the design concept for a flexible on-line graphic interactive tool for the extraction of features in signal classification problems. The report describes the rationale behind the system, the functional organization of the system from a user's point of view, and the software modules required for the operation of this large interactive system. Author (GRA)

**N72-21242#** Army Electronics Command, Fort Monmouth, N.J.
**THE DEVELOPMENT OF TACTICAL SYSTEM BENCHMARK PROGRAMS FOR TARGET ACQUISITION AND SURVEILLANCE APPLICATIONS**
Bernard J. Newman and James P. Wagner Jun. 1971 95 p refs
(DA PROJ. 1H6-63703-D-654)
(AD-735327; ECOM-3440) Avail: NTIS CSCL 09/2

The utilization of militarized computers in small tactical weapons applications is presented. Benchmark programs to be utilized as design verification tools for computer organizations and architectures are developed for typical signal enhancement and target acquisition signal processing applications. Implementations of the benchmark programs on a third generation militarized computer, the Texas Instruments Co. TI-CP-967, is presented. Author (GRA)

# 09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

**N72-21243*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**SWITCHING REGULATOR Patent**
Arthur G. Birchenough, inventor (to NASA) Issued 25 Jan.

1972 5 p Filed 3 Nov. 1970 Supersedes N71-28768 (09 - 16, p 2571)
(NASA-Case-LEW-11005-1; US-Patent-3,638,103;
US-Patent-Appl-SN-86548; US-Patent-Class-323-22T;
US-Patent-Class-323-38; US-Patent-Class-323-DIG.1) Avail: US Patent Office CSCL 09E

A switch connected between an unregulated DC power source and a load is controlled by a variable conductance device which compares the load voltage to a reference voltage. If the load voltage tends to increase above a predetermined value the variable conductance device tends to reduce the conduction of the switch. A hysteresis network provides feedback to the variable conductance device to produce a cumulative action so that the switch will turn off rapidly when the variable conductance device tends to reduce the conduction of the switch, and similarly, will turn on rapidly when the variable conductance device increases the conduction of the switch.

Official Gazette of the U.S. Patent Office

**N72-21244*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**STACKED ARRAY OF OMNIDIRECTIONAL ANTENNAS Patent**

Marion C. Bailey and William F. Croswell, inventors (to NASA) Issued 25 Jan. 1972 5 p Filed 24 Apr. 1970 Supersedes N70-35524 (08 - 19, p 3515)
(NASA-Case-LAR-10545-1; US-Patent-3,638,224;
US-Patent-Appl-SN-31703; US-Patent-Class-343-771;
US-Patent-Class-343-893) Avail: US Patent Office CSCL 09E

A stacked collinear array of independently fed omnidirectional antennas is described for use in collision warning systems of commercial aircraft. Each antenna consists of a dielectric filled coaxial transmission line with a uniform array of circumferential slots in the outer conductor. A sleeve balun is attached to each end of the transmission line for pattern control in the elevation plane and to provide some degree of isolation between antennas. Each antenna, except the top one, has a hollow center conductor of sufficient size to accommodate the feed cables for all antennas above it, thus eliminating a cable interference problem.

D.L.G.

**N72-21245*** Stanford Univ., Calif.

**MULTILOOP RC ACTIVE FILTER APPARATUS HAVING LOW PARAMETER SENSITIVITY WITH LOW AMPLIFIER GAIN Patent**

William J. Kerwin and Charles V. Shaffer, inventors (to NASA) Issued 16 Nov. 1971 12 p Filed 27 Feb. 1970 Supersedes N70-25958 (08 - 12, p 2189) Sponsored by NASA
(NASA-Case-ARC-10192; US-Patent-3,621,407;
US-Patent-Appl-SN-15024; US-Patent-Class-328-167;
US-Patent-Class-307-230; US-Patent-Class-307-295;
US-Patent-Class-328-142; US-Patent-Class-330-85;
US-Patent-Class-330-70R; US-Patent-Class-333-80) Avail: US Patent Office CSCL 09E

A filter network is described having at least two passive components and two voltage amplifiers, one of which has a positive gain K sub 1 which is less than unity, and the other providing a negative gain of magnitude of K sub 2 in the outer feedback loop. These circuits can provide any Q and can be made to oscillate with K sub 1 and K sub 2 within certain given ranges. Monolithic integrated circuit thick or thin film techniques are used in the preferred structure to provide the passive RC components. Official Gazette of the U.S. Patent Office

**N72-21246*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

**AUTOMATED EQUIPOTENTIAL PLOTTER Patent**

Earl R. Bunker, Jr., inventor (to NASA) Issued 30 Nov. 1971 6 p Filed 9 Dec. 1969 Supersedes N70-34628 (08 - 18, p 34628) Sponsored by NASA
(NASA-Case-NPO-11134; US-Patent-3,624,659;
US-Patent-Appl-SN-883524; US-Patent-Class-346-1;
US-Patent-Class-318-576; US-Patent-Class-324-71R;
US-Patent-Class-346-29) Avail: US Patent Office CSCL 09E

An apparatus is described for automatically drawing equipotential lines on a sheet of resistance paper, that has areas connected to different voltages of a voltage supply. An ordinary X-Y-plotter is used, but the ink pen is insulated from its surroundings, and a wire is connected from the pen to the terminal where the slide wire is normally connected. The plotter is set for automatic X-Sweep, and a preset voltage equal to that of the equipotential line to be drawn is connected to the Y-input of the plotter. As a result, the difference between the voltage at the pen and the preset voltage drives the pen up or down, so that it always contacts points on the resistance paper which are of the voltage of the equipotential line to be drawn.

Official Gazette of the U.S. Patent Office

**N72-21247*** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

**AUTOMATIC FREQUENCY CONTROL LOOP INCLUDING SYNCHRONOUS SWITCHING CIRCUITS Patent**

Frank Byrne, inventor (to NASA) Issued 19 Oct. 1971 8 p Filed 10 Sep. 1970
(NASA-Case-KSC-10393; US-Patent-3,614,648;
US-Patent-Appl-SN-71047; US-Patent-Class-331-14;
US-Patent-Class-307-257; US-Patent-Class-307-259;
US-Patent-Class-331-23; US-Patent-Class-331-30;
US-Patent-Class-331-111) Avail: US Patent Office CSCL 09E

A circuit for producing a precise and exact frequency reference that includes a voltage controlled oscillator, a crystal oscillator, a discriminator, an integrator, and a pair of electronic switches is described. One electronic switch alternately couples the frequencies from the voltage controlled oscillator and the crystal oscillator to the discriminator which produces alternate dc signals on its output. The second electronic switch produces a composite signal which is fed to the integrator for producing a corrective dc signal that is fed back to the voltage controlled oscillator to cause the signal to come in alignment with the crystal oscillator. Official Gazette of the U.S. Patent Office

**N72-21248*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**ELECTRO-MECHANICAL SINE/COSINE GENERATOR Patent Application**

Bruce Flagge, inventor (to NASA) Filed 24 Feb. 1972 10 p
(NASA-Case-LAR-10503-1; US-Patent-Appl-SN-229143) Avail: NTIS CSCL 09E

An electromechanical device for generating both sine and cosine functions is described. A motor rotates a cylinder about an axis parallel to and a slight distance from the central axis of the cylinder. Two noncontacting displacement sensing devices are placed ninety degrees apart, equal distances from the axis of rotation of the cylinder and short distances above the surface of cylinder. Each of these sensing devices produces an electrical signal proportional to the distance that it is away from the cylinder. Consequently, as the cylinder is rotated the outputs from the two sensing devices are the sine and cosine functions.

NASA

**N72-21249*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**A TEMPERATURE COMPENSATED LIGHT SOURCE USING A LIGHT EMITTING DIODE Patent Application**

Gordon J. Deboo and Clifford N. Burrous, inventors (to NASA) Filed 27 Dec. 1971 18 p
(NASA-Case-ARC-10467-1; US-Patent-Appl-SN-212028) Avail: NTIS CSCL 09A

A temperature compensated light source, composed of a thermistor, several resistors, an operational amplifier, and a light emitting diode, is described. These parts are combined so that the nonlinear characteristics of the thermistor cause the operational amplifier to vary the energizing current supplied to the light emitting diode to compensate for the nonlinear temperature characteristics of the diode. The radiant energy output of the light source is constant if a fixed input voltage is applied to this input terminal, or will vary in direct proportion to a variable input voltage applied to its input terminal. NASA

**N72-21250*#** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
**PRESSURIZED LIGHTING SYSTEM Patent Application**
Graydon A. Phlieger, Jr., inventor (to NASA) Filed 12 Feb. 1971 17 p
(NASA-Case-KSC-10644-1; US-Patent-Appl-SN-114849) Avail: NTIS CSCL 09E

A safety lighting system for a chain of lamps, each of which is housed within a hermetically sealed translucent tubular housing member is discussed. A control box is provided for supplying electrical power to the lamps in the lighting assemblies. A pressurized source of inert gas is fed through the control box of a predetermined pressure and through each of the sealed translucent tubular housing members. A pressure sensitive switch is provided in the control box for disconnecting the electrical power to the lamps when the pressure of the inert gas within any of the translucent tubular housing members drop below a predetermined level. NASA

**N72-21251*#** National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
**LOAD INSENSITIVE ELECTRICAL DEVICE Patent Application**
Francisc C. Schwarz, inventor (to NASA) Filed 6 Nov. 1970 35 p
(NASA-Case-XER-11046-2; US-Patent-Appl-SN-87597) Avail: NTIS CSCL 09A

A class of power converters is disclosed for supplying direct current at one voltage from a source at another voltage. The system includes a simple passive circuit arrangement of solid-state switches, inductors, and capacitors by which the output voltage of the converter tends to remain constant in spite of changes in load. The switches are sensitive to the current flowing in the circuit and are employed to permit the charging of capacitance devices in assordance with the load requirements. NASA

**N72-21252*#** General Dynamics/Convair, San Diego, Calif.
**DRIVING LAMPS BY INDUCTION Patent Application**
Helmut H. Laue and Leonard G. Clough, inventors (to NASA) Filed 16 Mar. 1972 9 p Sponsored by NASA
(NASA-Case-MFS-21214; US-Patent-Appl-SN-235269) Avail: NTIS CSCL 09C

An electrodeless lamp circuit is described which has a coil surrounding a krypton lamp driven by an RF input source tapped across an end part of the coil. A coil surrounding a mercury lamp is tapped across the connection of the input central to the krypton lamp coil. Each coil is connected in parallel with separate capacitors which form resonant circuits at the input frequency. NASA

**N72-21253*#** National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
**LEAD ATTACHMENT TO HIGH TEMPERATURE DEVICES Patent Application**
Richard Farrell, inventor (to NASA) Filed 28 Jan. 1972 16 p
(NASA-Case-ERC-10224-2; US-Patent-Appl-SN-221833) Avail: NTIS CSCL 09A

A technique is described for the attachment of leads to electronic devices. It permits operation of the devices over a wide temperature range. The technique contemplates the use of core conductors with a thin coating of metal, wereby only a limited amount of coating material is available to form an alloy which bonds the core conductor to the device electrode. The electrode composition is thus affected only in the region adjacent to the lead and the bond between the electrode and device is unaffected. NASA

**N72-21254*#** Westinghouse Electric Corp., Pittsburgh, Pa.
**DEMODULATOR FOR CARRIER TRANSDUCERS Patent Application**
Robert F. Roller, inventor (to NASA) Filed 24 Nov. 1971 16 p Sponsored by NASA
(NASA-Case-NUC-10107-1; US-Patent-Appl-SN-201700) Avail: NTIS CSCL 09E

A carrier type transducer is supplied with a carrier wave via an audio amplifier, a filter, a frequency divider, and an oscillator. The carrier is modulated in accordance with the parameter being measured by the transducer and is fed to the input of a digital data system, which may include a voltmeter. The output of the oscillator and the output of each stage of the divider are fed to on and or a nand gate and suitable variable and fixed delay circuits to the command input of the digital data system. With this arrangement, the digital data system is commanded to sample at the proper time, so that the average voltage of the modulated carrier is measured and may be utilized with ancillary circuitry for control of the parameter being measured by the transducer. NASA

**N72-21255*#** National Academy of Sciences-National Research Council, Washington, D.C.
**GYRATOR EMPLOYING FIELD EFFECT TRANSISTORS Patent Application**
Erwin S. Hochmair, inventor (to NASA) Filed 20 Mar. 1972 19 p Sponsored by NASA
(NASA-Case-MFS-21433; US-Patent-Appl-SN-236281) Avail: NTIS CSCL 09E

A gyrator circuit is described, having the conventional configuration of two amplifiers in a circular loop, one producing zero phase shift and the other producing 180 degree reversal. All active elements are MOS field effect transistors. Each amplifier comprises a differential amplifier configuration with current limiting transistor, followed by an output transistor in cascade configuration, and two load transistors of opposite conductivity type from the other transistors. A voltage divider control circuit comprises a series string of transistors with a central voltage input to provide control, with locations on the amplifiers receiving reference voltages by connection to appropriate points on the divider. The circuit produces excellent response and is well suited for fabrication by integrated circuits. NASA

**N72-21256#** Bendix Corp., Kansas City, Mo.
**ELECTRICAL TERMINATIONS: WELDED, BRAZED, AND BONDED Quarterly Report, Fiscal Year 1971**
D. E. Stittsworth Oct. 1971 59 p
(Contract at(29-1)-613)
(BDX-613-472; QR-FY71-4) Avail: NTIS

Work on in-process monitors, parallel-gap brazing of flexible copper circuit terminations, and evaluation of copper alloys is continuing. In-process monitors are being developed for opposed-electrode, parallel-gap, percussive-arc and pulse-arc welding processes. Flexible copper test coupons are being used to develop a parallel-gap brazing process for electrical termination to component pins and flexible circuits. The evaluation of copper alloys is being conducted to determine the effect of bulk wire fabrication processes on oxygen content within the copper alloy, and the effect of this oxygen content on the pulse-arc welding process. Author

**N72-21257#** Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
**TIME-TO-AMPLITUDE CONVERTER WITH A VERY SMALL ELECTRONIC RESOLVING TIME (2.2 ps)**
R. VanZurk Sep. 1971 16 p refs In FRENCH; ENGLISH summary
(CEA-N-1491) Avail: AEC Depository Libraries

This converter functions in conjunction with two fast gates using snap-off diodes, controlled by a semi-fast channel. The behavior of the time-to-amplitude converter is briefly discussed. The resolution time of the analyzer is 2.2 psec (full width and half height). NSA

**N72-21258#** European Space Research and Technology Center, Noordwijk (Netherlands).
**STUDY OF A dc/dc CONVERTER EMPLOYING A LINEAR**

**ANALOG PULSE WIDTH CONVERSION IN ITS CONTROL LOOP**
A. Capel Paris ESRO Mar. 1971 55 p refs In FRENCH; ENGLISH summary
(ESRO-TN-105-ESTEC) Avail: NTIS

A linear analog pulse width converter is introduced into the control loop of a dc/dc regulator, permitting the regulator to work at high synchronization frequencies. A theoretical analysis based on design parameters was made; a real model is presented, and its performance in test configurations is also described. The regulator is of the boost type and has an arbitrary regulated output voltage of 28 V. Author (ESRO)

**N72-21259#** ITT Electro-Physics Labs., Inc., Columbia, Md.
**A SURVEY AND ECONOMIC ASSESSMENT OF THE EFFECTS OF AIR POLLUTANTS ON ELECTRICAL COMPONENTS. VOLUME 1: SECTIONS 1 THROUGH 9 Final Report**
Aug. 1971 91 p refs
(Contract CPA-70-72)
(PB-204183; ETM-179-Vol-1; APTD-0797) Avail: NTIS CSCL 09C

Electronic components were divided into eleven different categories. The manner and amount of damage from air pollutants that might have been expected in each of these component categories was assessed by surveying the literature describing pollutant material damage mechanisms. The expected effects were compared with the actual experience of major manufacturing companies which appeared to account for most of the sales in each category. The literature survey indicated that gaseous sulfur compounds, notably sulfur dioxide, should be expected to account for most of the damage to electronic components. However, interviews with manufacturers revealed that particulate matter actually was responsible for most of the electronic component and equipment malfunctions currently being experienced. Author (GRA)

**N72-21260#** Army Foreign Science and Technology Center, Charlottesville, Va.
**ANALYSIS OF CROSSED-FIELD TRAVELLING-WAVE AMPLIFIER**
A. O. Volfson and G. L. Sobolev 22 Oct. 1971 12 p refs Transl. into ENGLISH of "K Analizu Usilitelya s Begushchei Volvoi so Skreshchennymi Polyami", unidentified Russian language article
(AD-735435; FSTC-HT-23-1037-1) Avail: NTIS CSCL 09/1

An investigation is made of the interactions of a spiral cluster of electrons, impelled by crossed homogeneous fields, with an electromagnetic wave in transmission lines. The transmission line can be either a coaxial wave guide or a structure elongated in the Z direction with azimuthal attenuation. Analysis of the interactions of a spiral electron cluster, moving in crossed fields, with an unattenuated electromagnetic wave, shows that in this case one obtains interactions of the O-type and of the M-type. Author (GRA)

**N72-21261#** IIT Research Inst., Chicago, Ill. Reliability Analysis Center.
**RELIABILITY CONSIDERATIONS IN PLASTIC ENCAPSULATED MICROCIRCUITS**
H. C. Edfors Dec. 1971 114 p refs Sponsored in part by RADC
(AD-735500; RAC-Tech-Mono-71-1) Avail: NTIS CSCL 09/5

The monograph provides the potential user of plastic encapsulated microcircuits with a firm understanding of the materials, design, and performance capability achievable with current industry practices in order that he may determine their suitability and reliability for a particular application. Author (GRA)

**N72-21262#** Varian Associates, Palo Alto, Calif.
**MEGAVOLT-MEGAMPERE ELECTRON GUN STUDY Final Report**
H. Jory, F. Friedlander, D. King, and C. Kuglin Nov. 1971 156 p refs
(Contract DASA01-69-C-0092)
(AD-735498; DNA-2730f) Avail: NTIS CSCL 09/1

The principal topic of this report is numerical analysis of electron flow in high current megavolt diodes, using a computer code developed by Varian Associates. Previous work had led to the conclusion that in high impedance megavolt diodes the cathode behaves essentially space charge limited and there is little if any ion neutralization of space charge in the flow. Presumably the source of electrons is a plasma which remains very near the cathode surface and which is formed by field emission heating of the surface during the early part of the pulse. Reported here are further efforts to verify the models used in the previous work. Calculations are compared with experimental results for diodes for which measured results were available. Also, electron flow calculations are presented for a number of 15 MV, 0.4 MA diode geometries, leading to some indications of how changes in the geometry affect the character of the beam. Also continued from the previous work were investigations of the feasibility of generating megavolt beams by using a cavity resonator as an rf energy storage element. Author (GRA)

**N72-21263#** Singer-Librascope, Glendale, Calif.
**ENVIRONMENTAL TEST PROGRAM FOR THE HIGH CONTRAST PHOTOCHROMIC PROJECTION DEVICE Final Report**
William S. Oakley and Clyde M. Whitey Nov. 1971 81 p
(Contract F30602-70-C-0161; AF Proj. 5597)
(AD-735281; K2.030; RADC-TR-71-241) Avail: NTIS CSCL 09/5

The report contains the results of a series of environmental tests conducted upon a laser-photochromic projection display. The display is based upon the random access positioning of a 1.06 micrometers laser beam by galvanometers and the thermal reversibility of exposed photochromic film. Author (GRA)

**N72-21264#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**LIMITED ELECTRONIC SCANNING WITH A NEAR-FIELD CASSEGRAINIAN-SYSTEM**
William D. Fitzgerald 24 Sep. 1971 28 p refs
(Contract F19628-70-C-0230; DA Proj. 7X2-63304-D-215)
(AD-735661; ESD-TR-71-271; TR-484) Avail: NTIS CSCL 09/5

The scanning characteristics of a near-field Cassegrainian antenna excited with a relatively small planar array are investigated theoretically and experimentally. The analysis uses both geometrical optics and scalar diffraction theory. The technique is a viable approach to the problem of modifying an existing high-resolution dish radar for limited scan capability. Feed requirements can be satisfied by virtually any planar array concept, i.e., phase scanning, frequency scanning, multiple-beam-forming networks, etc. The scan range is roughly approximated by a fixed angular field of view; hence, the number of beamwidths scanned with electrically large apertures can be very high. Further, the system is free from the coma lobes usually associated with off-axis beams from a paraboloid. Design curves are presented from which one can determine the secondary characteristics - gain, scan loss, sidelobes, etc. - for a given array/reflector configuration. Author (GRA)

**N72-21265#** TRW Systems Group, McLean, Va.
**SINGLE-SIDED LINEAR INDUCTION MOTOR (SLIM): A STUDY OF THRUST AND LATERAL FORCES Final Report**
R. S. Lipkis and T. C. Wang Jun. 1971 127 p refs
(Contract DOT-C-353-66)
(PB-205029; TRW-06818-W032-R0-00; FRA-RT-72-25) Avail: NTIS CSCL 09C

A steady-state linear analysis is presented of single-sided linear induction motors. Electromagnetic field equations are used to describe the magnetic field distribution across the air gap and inside the reaction rail, from which the induced current density

and force vectors are determined. The tangential component of the magnetic field and the secondary current result in a body force perpendicular to the stator surface. Analytical expressions for this lateral force and the thrust parallel to the stator surface are derived. Special attention is given to the magnitude of the lateral force under various design conditions. It appears that a SLIM can be used for both the propulsion and the levitation of a high-speed vehicle for ground transportation. Author (GRA)

N72-21266# Harry Diamond Labs., Washington, D.C.
**SHORT PULSE RF BURNOUT PROPERTIES OF CRYSTAL DIODE MIXERS IN THE 4-MM BAND**
Abraham Singer Nov. 1971 37 p refs
(AD-735341; HDL-TR-1566) Avail: NTIS CSCL 09/5

The short-pulse RF burnout properties of the commercially available crystal diode mixers in the 4-mm band were examined by use of stable, 1-ns, 70-GHz pulses of controlled amplitude. The examination included the four basic types of 40mm band diodes: silicon, germanium, and gallium arsenide point contacts, and an experimental Schottky barrier. Several 1N53s, silicon point contacts designed to operate at 8.6 mm, were included for comparison. Author (GRA)

N72-21267# Radio Corp. of America, Princeton, N.J.
**DC-ELECTROLUMINESCENT FLAT PANEL DISPLAY Quarterly Report, 1 Jul. - 30 Sep. 1971**
Joseph J. Hanak, P. Neil Yocom, and J. Gordon Davy Jan. 1972 34 p refs
(Contract DAAB07-69-C-0290; DA Proj. 1H6-62705-A-055)
(AD-735342; PRRL-71-CR-36; ECOM-0290-9; QR-9) Avail: NTIS CSCL 09/5

The object to develop efficient electroluminescent (EL) heterojunctions has been intensified. In the heterojunction approach several concepts were studied. The main effort was on the semi-permeable barrier concept in which high bandgap materials are sandwiched between the EL film and the metal electrode. Author (GRA)

N72-21268# Radio Corp. of America, Somerville, N.J. RCA Solid State Div.
**COMMON-BASE VERSUS COMMON-EMITTER PERFORMANCE AND RELIABILITY FOR VHF STAGES Final Report, 25 Feb. 1970 - 24 Mar. 1971**
Z. F. Chang Jan. 1972 64 p refs
(Contract DAAB07-70-C-0145; DA Proj. 1H6-62705-A-056)
(AD-735755; ECOM-0145-F) Avail: NTIS CSCL 09/5

Two broadband amplifier chains were developed for operation with a minimum output power of 10 watts over the 225- to 400-megahertz band. Four stages were used in each chain, with each stage having 50-ohm input and output terminals. The stages in one amplifier chain operated in the common-base configuration; the other chain used common-emitter stages. Comparison of the RF performance of the two amplifier chains showed that common-base amplifiers provided a flatter output response, a higher power gain, and a lower input VSWR than common-emitter amplifiers. Infrared scanning performed on the output stages indicated that the common-base amplifier also had a lower junction spot temperature. In high-power common-base operation, extremely low base-lead inductance was necessary to prevent the amplifier from becoming regenerative. Author (GRA)

N72-21269# Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center.
**A PARTIAL LIST OF ULTRAHIGH FREQUENCY REFERENCES CONTAINING MATERIALS/PROPERTY DATA Interim Report**
John T. Milek Mar. 1971 9 p refs Sponsored by DASA and AFML
(AD-735621; EPIC-IR-15) Avail: NTIS CSCL 11/7

The references incluided contain property data above 1 MHz and range into the millimeter and submillimeter ranges. The amount of high frequency data in the microwave region is quite limited in contrast to the common 1 kHz or 1 MHz. Author (GRA)

N72-21270# Army Electronics Command, Fort Monmouth, N.J.
**A COMPARATIVE ANALYSIS OF FLAT PANEL DISPLAY TECHNOLOGY FOR FIXED FORMAT APPLICATIONS**
Elliott Schlam and Irving Reingold Sep. 1971 22 p
(AD-735329; ECOM-3481) Avail: NTIS CSCL 09/5

An analysis has been made to assess the merits of a number of different technologies that are being proposed as means for developing flat-panel display devices. The specific technologies considered include plasma display panels, light-emitting diodes, electroluminescent films, liquid crystals, and digital-address flat cathode-ray tubes. This analysis is limited to a fixed-format display capability. Qualitative ratings and descriptions for display parameters of interest are presented in a matrix chart form that permits a comparison to be made between the technologies reviewed. A discussion of the parameters and properties under consideration points out both the merits and shortcoming of each particular approach. Author (GRA)

N72-21271# Naval Postgraduate School, Monterey, Calif.
**INDUCTORLESS BANDPASS FILTER REALIZATION USING THE RIORDAN GYRATOR M.S. Thesis**
Robert Edward Mollet Sep. 1971 80 p refs
(AD-736533) Avail: NTIS CSCL 09/5

The scope of the thesis is to analyze the parameters of the Riordan gyrator and those of an inductor and those of an inductor simulated using it, and to investigate the use of simulated inductors in electric filter networks. To illustrate and support the theory surrounding the Riordan gyrator, an inductorless bandpass filter is designed, constructed, and tested. Author (GRA)

N72-21272# Naval Postgraduate School, Monterey, Calif.
**A MATRIX ELEMENT OF A SOLID STATE ULTRASONIC IMAGE CONVERTER USING A LIGHT EMITTING DIODE IN A NONSCANNING DISPLAY M.S. Thesis**
Peter Arnold Trump Sep. 1971 42 p refs
(AD-736535) Avail: NTIS CSCL 09/5

A mosaic transducer array at the focal plane of an acoustic lens followed by suitable electronic circuitry can be used to produce an image of an object. The report contains a study of a design which would use a mosaic of light emitting diodes to produce the image directly without recourse to scanning. A single channel of such a system was designed which responds to voltage levels at the transducer of less than ten microvolts at a frequency of 500 kHz. Author (GRA)

# 10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see specific Physics categories.

N72-21273# Royal Aircraft Establishment, Farnborough (England).
**AN ANALYTICAL METHOD FOR INVESTIGATING THE TRANSIENT PROCESSES IN A SINGLE PHASE BRIDGE RECTIFIER CIRCUIT**
I. A. Zborovskii and A. A. Yanko-Trinitskii Nov. 1971 20 p refs Transl. into ENGLISH from elektrichestvo (Moscow), v. 8, 1966 p 14-18
(RAE-Lib-Trans-1620; BR-28527) Avail: NTIS

An analysis is given of the single phase bridge rectifier circuit, subject to certain restrictions being placed on the circuit parameters, whereby values of the rectified current are determined at discreet points in the transient process. Expressions are given

for the time constant tau for the transient process when the commutation period 0 < or = gamma < or = pi and when pi < or = gamma < or 2 pi. Author

N72-21274*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**BEAM LEAD INTEGRATED CIRCUIT PACKAGE, AND METHOD Patent Application**
Bobby W. Kennedy, inventor (to NASA) Filed 27 Mar. 1972 12 p
(NASA-Case-MFS-21374; US-Patent-Appl-SN-238047) Avail: NTIS CSCL 09C

A beam lead integrated circuit package assembly is described, which includes a beam lead integrated circuit chip, a lead frame array bonded to projecting fingers of the chip, a rubber potting compound disposed around the chip, and an encapsulating molded plastic. The lead frame array is prepared by photographic printing of a lead pattern on a base metal sheet, selectively etching to remove metal between leads, and plating with gold. Joining of the chip to the lead frame array is carried out by thermocompression bonding of mating gold-plated surfaces. A small amount of silicone rubber is then applied to cover the chip and bonded joints, and the package is encapsulated with epoxy resin, applied by molding. NASA

N72-21275*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**VIBRATION MODE SYNTHESIZER Patent Application**
Eugene C. Naumann and Gideon J. Hagwood, inventor (to NASA) Filed 26 May 1971 8 p
(NASA-Case-LAR-10310-1; US-Patent-Appl-SN-147103) Avail: NTIS CSCL 09C

A simple highly flexible device for synthesizing complex vibration mode patterns, is presented. These mode patterns can be used to identify vibration mode data. This device sums selected sine and cosine functions and then plots the sum against a linear function. NASA

N72-21276*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**DIODE QUAD TRANSDUCER AND DISCRIMINATOR CIRCUIT Patent Application**
John Dimeff and Dean R. Harrison, inventors (to NASA) Filed 20 Dec. 1971 19 p
(NASA-Case-ARC-10364-1; US-Patent-Appl-SN-209618) Avail: NTIS CSCL 09C

A transducer and frequency discriminator circuit is described, which includes a four-terminal circulating diode bridge, a pair of capacitors connected in series across two terminals of the bridge, and a second pair of capacitors, or other impedace elements, connected in series across the other two terminals of the bridge. A source of balanced alternating electrical energy for energizing the circuit is coupled between the commonly connected plates of the first pair of capacitors and the commonly connected plates of the second pair of capacitors. Due to the operation of the diode bridge, the sum of the resultant charges developed on the first pair of capacitors is proportional to the relationship between the respective capacitors of the second pair, and consequently, an output voltage taken across the first pair of capacitors will be proportional to that relationship. NASA

N72-21277# Sandia Labs., Livermore, Calif.
**METHOD FOR DESIGNING FEEDBACK NETWORKS INSENSITIVE TO VARIATIONS IN AMPLIFIER GAINS**
M. A. Soderstrand Dec. 1971 40 p refs
(Contract AT(29-1)-789)
(SCL-DR-710094) Avail: NTIS

How the stability problem can be overcome is described, using a method for designing negative or positive feedback circuits such that the instability of the active elements has no effect upon the critical operation of the circuit. The instability of the active elements in a circuit is compensated for by adjusting the appropriate RC products. The net result is that circuits with the required quality factor and resonant frequency can be designed using inexpensive, low tolerance active elements and still obtain a perfect rating according to both the old and new figures of merit. Author

N72-21278# RAND Corp., Santa Monica, Calif.
**SOVIET CYBERNETICS REVIEW, VOLUME 4, NO. 10, 1970 (INDEX)**
Wade B. Holland, ed. Aug. 1971 70 p refs
(Contract F44620-67-C-0045)
(AD-735651; RM-6200/10-PR) Avail: NTIS CSCL 09/2

A set of indexes to the 1970 issues of Soviet Cybernetics Review, and a bibliography with abstracts of 18 other Rand publications in the field are presented. As in previous years, there are detailed indexes of subjects, of personalities--including authors, persons mentioned, and persons pictured--of organizations, and of hardware/software items. Author (GRA)

N72-21279# Florida Univ., Gainesville. Dept. of Industrial and Systems Engineering.
**STEADY-STATE ANALYSIS OF DELAYS IN OPEN AND CLOSED NETWORKS**
R. L. Patterson Oct. 1971 22 p refs
(Contract DAHC04-68-C-0002; Proj. THEMIS)
(AD-735348; TR-56) Avail: NTIS CSCL 12/2

The steady-state analysis of open or closed networks consisting of n nodes interconnected by links over which mass flows is the subject of the report. Formulas are derived which yield the equilibrium mass balance at each node in terms of a set of specified parameters which characterize both nodes and links. The solution is then generalized to the case of a k-priority network of interconnected nodes, either open or closed. K-priority systems are solved recursively and formulas are given which determine delays at each node for a fixed priority mass element in terms of known parameters. Author (GRA)

N72-21280# Stanford Univ., Calif. Digital Systems Lab.
**A LOWER BOUND FOR SORTING NETWORKS THAT USE THE DIVIDE-SORT-MERGE STRATEGY**
David C. VanVoorhis Aug. 1971 17 p refs
(Contract N00014-67-A-0112-0044; NSF GJ-1180)
(AD-735901; SU-SEL-71-051; SU-CS-71-238; TR-17) Avail: NTIS CSCL 09/2

Let M sub g(g sup(K+1)represent the minimum number of comparators required by a network that merges g ordered sets containing g sup K members each. In the paper the author proves that M sub g (g(sup K+1))or = g (m sub g)(g supK) + the summation from i = 2 to g of ((i-1)g/i). From this relation the author is able to show that an N-sorter which uses the g-way divide-sort-merge strategy recursively must contain about N (log to the base 2 of N) squared comparators. Author (GRA)

## 11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N72-21281*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**ELECTROTHERMAL FOLLOW DISPLAY APPARATUS FOR ELECTROEXPLOSIVE DEVICE TESTING**
Louis A. Rosenthal and Vincent J. Menichelli 15 Mar. 1972 19 p refs

(Contract NAS7-100)
(NASA-CR-125931; JPL-TR-32-1554) Avail: NTIS CSCL 14B

A self-balancing bridge for ascertaining the electrothermal and nonlinear behavior of an electroexplosive device is described. A sinusiodal current is passed through the device which provides a signal in the form of a unique Lissajous display. The display can be qualitatively evaluated and abnormal units can be readily detected. Author

**N72-21282*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

**HIGH ENERGY ASTRONOMY OBSERVATORY, MISSION C, PHASE A. VOLUME 1: EXECUTIVE SUMMARY Final Report**

Jan. 1972 110 p
(NASA-TM-X-64652-Vol-1) Avail: NTIS CSCL 14B

A summary of the Phase A of the High Energy Astronomy Observatory Mission-C (HEAO-C) is presented. The mission, baseline experiments, observatory design, and spacecraft subsystems are described, and the principal mission considerations are discussed. A summary is included of the general recommendations. F.O.S.

**N72-21283*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

**HIGH ENERGY ASTRONOMY OBSERVATORY, MISSION C, PHASE A. VOLUME 2: PRELIMINARY ANALYSES AND CONCEPTUAL DESIGN Final Report**

Jan. 1972 724 p refs
(NASA-TM-X-64652-Vol-2) Avail: NTIS HC $9.00/MF $0.95 CSCL 14B

An analysis and conceptual design of a baseline mission and spacecraft are presented. Aspects of the HEAO-C discussed include: baseline experiments with X-ray observations of space, analysis of mission requirements, observatory design, structural analysis, thermal control, attitude sensing and control system, communication and data handling, and space shuttle launch and retrieval of HEAO-C. F.O.S.

**N72-21284*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

**HIGH ENERGY ASTRONOMY OBSERVATORY, MISSION C, PHASE A. VOLUME 3: APPENDICES Final Report**

Jan. 1972 698 p refs
(NASA-TM-X-64652-Vol-3) Avail: NTIS HC $9.00/MF $0.95 CSCL 14B

Technical data, and experiment and spacecraft alternatives are presented in support of the HEAO-C, whose primary objective is a detailed study of the more interesting high energy sources, using grazing incidence X-ray telescopes and a spacecraft pointing accuracy of + or - 1 arc minute. The analyses presented cover the mission analysis and launch vehicle; thermal control trade studies and supporting analyses; attitude sensing and control analyses; electrical systems; and reliability analysis. The alternate experiments which were considered are listed, and the advantages and disadvantages of several alternate observatory configurations are assessed. M.G.J.

**N72-21285*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**FINAL ENVIRONMENTAL IMPACT STATEMENT FOR LANGLEY**

17 Aug. 1971 69 p refs
(NASA-TM-X-67680; PB-202053-F) Avail: NTIS CSCL 14B

The Langley Research Center is described, together with the nature of its activities, from which it can be seen that the Center is basically not a major pollution source. Geographical, geological, and climatic charateristics of the site are also described. inasmuch as they influence both the choice of disposal methods and the environmental effects of the pollutants. The known or probable pollution sources at the Center are described. Where the intensities of these sources might exceed the recommended guide-lines, the corrective actions that have been taken or are being taken are described. The entire inventory of pollution sources and control methods is summarized in an appendix. Author

**N72-21286*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**FINAL ENVIRONMENTAL IMPACT STATEMENT FOR AMES RESEARCH CENTER**

Jul. 1971 28 p
(NASA-TM-X-67669; PB-202055-F) Avail: NTIS CSCL 14B

The NASA-Ames Research Center is described. together with the nature of its activities, from which it can be seen that the center is basically not a major pollution source. Geographical, and climatic characteristics of the site are described. inasmuch as they influence both the choice of disposal methods and the environmental effects of the pollutants. The known or probable pollution sources at the center are described. Where the intensities of these sources might exceed the recommended guidelines, the corrective actions that have been taken are described. Author

**N72-21287*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**DEVELOPMENT OF A DIGITAL CONTROL SYSTEM FOR A SPACECRAFT PROPULSION TEST FACILITY**

Robert R. Smalley 1972 6 p Proposed for presentation at 18th Natl. Aerospace Instrumentation Symp., Miami Beach, Fla., 15-17 May 1972
(NASA-TM-X-68040; E-6873) Avail: NTIS CSCL 14B

A digital computer control and abort system which is used at NASA-Lewis research center is described. The system was designed to control test operations such as rocket engine testing, structure testing, and wind tunnel tests. Because of the nature of spacecraft system testing, particularly rocket engine testing, the unique features of the system are, control function updating at a 20 millisecond rate, continuous abort monitoring and a software system designed for short duration tests rather than continuous on-line control. To accomplish these system requirements, special hardware was designed. The presentation includes a description of the computer system and special interface hardware as well as a general description of the software used. Author

**N72-21288*#** Louisiana State Univ., Baton Rouge. Dept. of Mechanical, Aerospace and Industrial Engineering.

**WIND TUNNEL BALANCE SYSTEM FOR DETERMINATION OF WIND-INDUCED VIBRATIONS OF A RIGID SHUTTLE MODEL IN THE LAUNCH CONFIGURATION Graduate Engineering Practice in Mechanical Engineering. Final Report, Feb. - Aug. 1971**

22 Sep. 1971 154 p refs
(Contract NAS9-10464)
(NASA-CR-115531; MSC-01500) Avail: NTIS CSCL 14B

A wind tunnel balance system was designed to determine the wind-induced vibrations of a space shuttle model. The balance utilizes a flexible sting mounting in conjunction with a geometrically scaled rigid model. Bending and torsional displacements are determined through strain-gauge-instrumented spring bar mechanisms. The natural frequency of the string-model system can be varied continuously throughout the expected scaled frequency range of the shuttle vehicle while a test is in progress by the use of moveable riders on the spring bar mechanism. Through the use of a frequency analyzer, the output can be used to determine troublesome vibrational frequencies. A dimensional analysis of the wind-induced vibration problem is also presented which suggests a test procedure. In addition a computer program for analytical studies of the forced vibration problem is presented. Author

**N72-21289*#** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

**NASA, JOHN F. KENNEDY SPACE CENTER ENVIRONMEN-**

**TAL IMPACT STATEMENT Final Report**
29 Sep. 1971 16 p
(NASA-TM-X-67740; PB-203059-F) Avail: NTIS CSCL 14B

The probable total impact of the John F. Kennedy Space Center (KSC) operations on the environment is discussed in terms of launch operations emissions and environmental quality. A schedule of planned launches through 1973 is included with a description of the systems for eliminating harmful emissions during launch operations. The effects of KSC on wild life and environmental quality are discussed along with the irreversible and irretrievable commitments of natural resources. F.O.S.

**N72-21290#** Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
**AN ESTIMATE OF THE POWER REQUIRED TO ELIMINATE TRAILING VORTICES BY SUCTION**
J. Menkes and F. A. Abernathy (Harvard Univ., Cambridge, Mass.) May 1970 47 p refs
(IDA-Log-HQ-69-10164; P-514; Res-Paper-P-514) Avail: NTIS

The use of suction devices in controlling the trailing vortex hazard for closely spaced parallel runways is examined. The feasibility of this proposal is examined by means of a computer simulation. It is established conclusively that the scheme has merit and that the power required to bring the hazard to acceptable levels is of the order of 2,000 hp per runway.
Author

**N72-21291#** European Space Research Organization, Paris (France).
**SPACECRAFT OPERATIONS. VOLUME 1: INTRODUCTION, SYSTEMS ASPECTS AND MISSION COORDINATION**
Apr. 1971 72 p Partly in ENGLISH and partly in FRENCH Proc. of the 8th ESRO Summer School, Neu-Isenburg, West Ger., 1970
(ESRO-SP-64) Avail: NTIS

Project coordination, mission support, and general systems in a spacecraft operations center are summarized. Coherent detection methods for space communication and a typical onboard telecommunications system are also discussed. Generation of data onboard scientific satellites is considered, selecting typical experiments from ESRO satellites in relation to the analog and digital nature of data involved. For individual titles, see N72-21292 through N72-21295.

**N72-21292#** European Space Operations Center, Darmstadt (West Germany).
**INTRODUCTION TO THE COURSE: SYSTEM CONCEPTS IN SPACECRAFT CONTROL AND OPERATIONS**
U. Montalenti *In* ESRO Spacecraft Operations, vol. 1 Apr. 1971 p 3-11 (See N72-21291 12-11)
Avail: NTIS

The activities of the ESRO Operations Center are discussed. The system concept is one of interaction between the customer and the satellite with the center doing the spacecraft control, codifying of scientific experiments, and subsequent processing of data.
ESRO

**N72-21293#** European Space Operations Center, Darmstadt (West Germany).
**PROJECT COORDINATION AND MISSION SUPPORT IN ESOC**
G. Dondi *In* ESRO Spacecraft Operations, vol. 1 Apr. 1971 p 13-36 (See N72-21291 12-11)
Avail: NTIS

The activities of EROC are broadly introduced against the background of the European space programs, and the need for for coorination between an establishment organized by functions and space activities is discussed. The various aspects of mission support preceding launch of a spacecraft are emphasized, the concept of mission requirements and ESOC commitments are explained, and the interactive character of this support function is shown. The problems of mission support after launch of a spacecraft are analyzed, together with the changing roles of the project team and scientists. Mission support during the lifetime of a single project, and coordination and support for several concurrent projects are examined. Typical case studies are introduced to show the practical impact of providing mission support in an environment having the usual budget, manpower, and structural limitations of an organization. Author (ESRO)

**N72-21294#** European Space Research and Technology Center, Noordwijk (Netherlands).
**COHERENT DETECTION METHODS FOR SPACE COMMUNICATION** c07
R. W. Okkes *In* ESRO Spacecraft Operations, vol. 1 Apr. 1971 p 39-50 (See N72-21291 12-11)
Avail: NTIS

Different detection methods for binary data transmitted on a satellite telemetry link are described and their performances compared. Coherent detectors for demodulation of phase shift keyed, modulated data using phase locked techniques are also considered.
Author (ESRO)

**N72-21295#** European Space Research and Technology Center, Noordwijk (Netherlands).
**DATA GENERATION ON BOARD SATELLITES [GENERATION DES DONNEES A BORD DES SATELLITES]** c07
J. Toussaint *In* ESRO Space Operations, vol. 1 Apr. 1971 p 53-65 In FRENCH (See N72-21291 12-11)
Avail: NTIS

A number of experiments in ESRO satellites are described to illustrate how diverse the methods of data transmission are and the constraints and problems imposed upon them, Taking into account the technical state of the art and its complexity, it is suggested that onboard computers would resolve problems of future missions.
ESRO

**N72-21296#** European Space Research Organization, Paris (France).
**SPACECRAFT OPERATIONS. VOLUME 3: SPACECRAFT AND NETWORK CONTROL**
Jun. 1971 65 p refs Partly in ENGLISH and partly in FRENCH Proc. of the 8th ESRO Summer School, Neu-Isenburg, West Ger., 1970
(ESRO-SP-66) Avail: NTIS

The control of satellites in orbit and coordination of the ground station network are discussed. The space flight operations system and the technical concept of the German ground operations for the Azur satellite are outlined. The passive and active aspects of spacecraft operations are also summarized, including applicable software and hardware. For individual titles, see N72-21297 through N72-21300.

**N72-21297#** Centre National d'Etudes Spatiales, Bretigny-sur-Orge (France). Div. Operations.
**SATELLITE CONTROL AND COORDINATION OF A CONTROL STATION NETWORK [LE CONTROLE DES SATELLITES ET L'ORGANISATION D'UN RESEAU DE STATIONS DE CONTROLE]**
J. Blachon *In* ESRO Spacecraft Operations Jun. 1971 p 1-16 refs In FRENCH (See N72-21296 12-11)
Avail: NTIS

The qualities of a ground station network capable of assuring an efficient control of satellites are defined. The different control operations (tracking, PCM telemetry, remote control) are analyzed and the principal techniques given. The ground station data transmission network of CNES is described.
ESRO

**N72-21298#** European Space Operations Center, Darmstadt (West Germany).
**PHILOSOPHY OF NETWORK MANAGEMENT AND SPACECRAFT CONTROL AT ESOC**

G. Harris, Jr. *In* ESRO Spacecraft Operations Jun. 1971 p 19-27 (See N72-21296 12-11)
Avail: NTIS

The activities of the spacecraft data acquisition department at ESOC are described by means of line drawings with the purpose of emphasizing the prevailing attitude towards operational network and spacecraft control. ESRO

**N72-21299#** European Space Operations Center, Darmstadt (West Germany).
**CONTROL OF SPACECRAFT DURING THEIR LIFE TIME [LE CONTROLE DES VEHICULES SPATIAUX DURANT LEUR VIE UTILE]** c07
G. Valentiny *In* ESRO Spacecraft Operations Jun. 1971 p 31-50 In FRENCH (See N72-21296 12-11)
Avail: NTIS

The passive and active means of controlling spacecraft are described together in relation to ESRO satellites with the data transmission and processing methods used at ESOC. ESRO

**N72-21300#** European Space Operations Center, Darmstadt (West Germany).
**NETWORK CONTROL METHODS AND PROCEDURES AS USED AT ESOC**
David Wilkins *In* ESRO Spacecraft Operations Jun. 1971 p 51-60 (See N72-21296 12-11)
Avail: NTIS

Network control functions, network data requirements, and factors which contribute to effective network control are discussed. Tracking, telemetry, and command are described, as well as the basic considerations influencing network operations (status of operational system, scientific data requirements and priorities, spacecraft control data requirements, orbital elements, and imposed limitations). Procedures and documentation for effective management of operations is also described. Author (ESRO)

**N72-21301#** Brookhaven National Lab., Upton, N.Y. Accelerator Dept.
**HIGH FIELD BENDING MAGNET FOR HIGH ENERGY STORAGE RINGS**
G. Parzen and K. Jellett 10 Nov. 1971 10 p ref Sponsored by AEC
(BNL-16299; AADD-184; CRISP-71-41) Avail: NTIS

A circular magnet with a cosine current distribution and a 2 in. aperture is proposed which fulfills suggested tolerances for bending magnets in high-energy storage rings while reaching a field of 40 kG. The iron shield can be chosen to keep the higher multipoles in the magnetic field small so that a correction coil is required only for the sextupole term in the magnetic field.
Author (NSA)

**N72-21302#** Rouen Univ. (France). Faculte des Sciences.
**SHOCK TUBE FOR OPTICAL STUDIES ON AN ARGON PLASMA** Ph.D Thesis
Claude Thenard 1970 87 p refs In FRENCH
(FRNC-TH-70) Avail: AEC Depository Libraries

A clean shock tube was developed for studies on the structure of shock waves. Spectroscopic measurements on plasmas were envisaged. The shock tube is described and its suitability for the measurements to be made demonstrated. The relaxation time measured corresponds to the amount of impurity in the argon used. The values of the parameters deduced from the optical measurements agree with those of Grier. The preliminary results obtained demonstrate that absolute intensities of the lines and background continuum were measured to a high degree of accuracy. Curves relating to the evolution in the electronic density confirm the analytic expressions given by Petschek for the relaxation and cooling zones near to the equilibrium. NSA

**N72-21303#** Brookhaven National Lab., Upton, N.Y.
**AIR-CORE AND IRON-CORE MAGNETS AND LENSES WITH WINDINGS OF FINITE THICKNESS FOR ACCELERATORS**
V. G. Davidovskii Nov. 1970 150 p refs Transl. into ENGLISH of Akad. Nauk SSSR, Inst. Yadernoi Fiziki, Novosibirsk, report IYAF-40-70
(BNL-tr-447) Avail: NTIS

The results of calculations of the air-core and iron-core conductor magnets that produce a prescribed constant magnetic field in the cylindrical region of circular cross section, when windings with a constant current density are used, are presented and discussed. Also, methods are suggested for calculating air-core magnets for producing a field in the elliptic and rectangular regions and iron-core conductor magnets for producing a quadrupole field in the rectangular region. NSA

**N72-21304#** Institut Franco-Allemand de Recherches, St. Louis (France).
**THE EXPERIENCE OF INTERNATIONAL COOPERATION AT THE ISL IN THE FIELD OF SPECIFIC AERODYNAMIC FACILITIES**
A. Auriol 8 Apr. 1971 32 p refs In FRENCH; ENGLISH summary Presented at the Seminaire sur les Probl. Gen. relatifs aux Moyens d'Essais Aerodyn., Saint-Louis, France, 4-7 May 1971
(ISL-4/71) Avail: NTIS

The advantages resulting from international cooperation in the field a specific aerodynamic facilities are reviewed. The facilities included: (1) ballistic ranges; (2) sonic boom generator; and (3) galleries for simulating nuclear blast-waves. After a brief description of these installations and the advantages involved, it is shown how ISL contributed to this cooperation in practice. It is suggested that efforts towards cost-effectiveness will promote cooperation whereas excessive security tendencies will be disadvantageous. How ISL can help to accelerate and improve this cooperation is emphasized. ESRO

**N72-21305#** National Bureau of Standards, Washington, D.C. Technical Analysis Div.
**SEARCH AND RESCUE SIMULATION MODEL. PHASE 3 REPORT: CALIBRATION/VALIDATION/INVESTIGATION**
Stephen S. Karp 1971 228 p refs Sponsored in part by the Coast Guard
(NBS Proj. 4314561)
(AD-735418; NBS-10624) Avail: NTIS CSCL 06/7

The Search and Rescue Simulation (SARSIM) model developed for the U. S. Coast Guard has been subjected to a series of calibration runs, validation tests and investigative exercises. This report presents the results of the associated computer runs and their analyses. It also describes some sample exercises made to demonstrate the model's utility as a long-range planning tool. The report concludes with a summary of some significant findings made from these exercises; an assessment of the current SARIM model; and recommendations for future model refinements. Author (GRA)

**N72-21306#** Goodyear Aerospace Corp., Akron, Ohio.
**EXPANDABLE FLOATING BASES Final Report**
Glenn W. Quaint and Eldon C. Lown 14 Jan. 1972 110 p refs
(Contract N00014-70-C-0361; ARPA Order 1645)
(AD-735491; GER-15491) Avail: NTIS CSCL 13/10

The report describes an investigation conducted to determine the technical feasibility of utilizing large expandable structures which can be joined together to form a Floating Island Base. The objectives in using expandable structures in this application were to develop a floating base which could be packaged, transported, and erected employing a minimum of time and effort. The missions for a base of this type would be of a temporary nature and therefore the island must also be capable of being repackaged for redeployment. Author (GRA)

**N72-21307#** National Aeronautical Establishment, Ottawa (Ontario).
**HIGHER ORDER THEORY OF TWO DIMENSIONAL SUBSONIC WALL INTERFERENCE IN A PERFORATED WALL WIND TUNNEL**
M. Mokry Oct. 1971 33 p refs
(AD-735967; NAE-LR-553; NRC-12370) Avail: NTIS CSCL 14/2

The analytic solution for the interference velocity potential due to a source and a vortex between perforated wind tunnel walls has been extended to higher-order singularities. This allows a more accurate construction of the primary perturbation potential at the walls produced by the tested airfoil. The solution for the interference velocity at the position of the model is presented in the form of a series expansion, with Bernoulli polynomials of a suitably chosen function of wall porosity as coefficients. The discussion is limited to subsonic flow and a thin airfoil of small camber and incidence, placed midway between the perforated walls. GRA

**N72-20993#** Centre d'Essais en Vol, Istres (France).
**SCHOOL OF NAVIGATION PERSONNEL FOR TESTS AND RECEPTION [L'ECOLE DU PERSONNEL NAVIGANT D'ESSAIS ET DE RECEPTION]**
Francois Cousson *In* AGARD Flight Test Tech. Feb. 1972 11 p In FRENCH (See N72-20976 12-02)
Avail: NTIS

**N72-20994#** Air Force Flight Test Center, Edwards AFB, Calif.
**US AIR FORCE AEROSPACE RESEARCH PILOT SCHOOL**
Spence M. Armstrong *In* AGARD Flight Test Tech. Feb. 1972 8 p (See N72-20976 12-02)
Avail: NTIS

**N72-20995#** Royal Air Force, Farnborough (England).
**TRAINING PILOTS TO ASSESS FLIGHT SYSTEMS AT THE EMPIRE TEST PILOTS' SCHOOL**
A. A. Clark *In* AGARD Flight Test Tech. Feb. 1972 6 p (See N72-20976 12-02)
Avail: NTIS

**N72-20996#** Naval Air Test Center, Patuxent River, Md.
**US NAVAL TEST PILOT TRAINING**
Robert V. Sallada *In* AGARD Flight Test Tech. Feb. 1972 15 p (See N72-20976 12-02)
Avail: NTIS

# 12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

**N72-21308** National Lending Library for Science and Technology, Boston Spa (England).
**EFFECT OF MASS TRANSFER ON THE RHEOLOGICAL BEHAVIOUR OF FLUIDS**
J. R. A. Pearson Feb. 1971 12 p refs Transl. into ENGLISH from the book "Teplo- i Massoperenos: 3 Teplo- i Massoperenos v Reologicheskikh Sistermakh' Minsk, 1968 p 167-181
(NLL-RTS-6990) Avail: Natl. Lending Library, Boston Spa, Engl.: £1.10; 4 NLL photocopy coupons

Mathematical flow models are presented for simple fluids. Steady flow is discussed for a circular tube with constant cross section and for a plane channel. Irregular flow of melts in capillaries is also considered. K.P.D.

**N72-21309** National Lending Library for Science and Technology, Boston Spa (England).
**A CONTRIBUTION TO THE GEOMETRICAL THEORY OF STEADY MOTION OF A FLUID**
V. V. Sluhaev [1971] 8 p refs Transl. into ENGLISH from Dokl. Akad Nauk SSSR (Moscow), v. 196, 1971 p 549-552
(NLL-M-22062-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Conditions are considered under which a field of unit vectors may serve as a field of velocity directions for steady barotropic flow of an ideal fluid. If much conditions are known, the problem of the possibility of flow with a given distribution of streamlines can be solved. A method is presented which is similar to the method of differential relationships which is used in the theory of differential equations. Author

**N72-21310*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**LIQUID AEROSOL DISPENSER Patent**
Robert J. Naumann and David W. Jex, inventors (to NASA) Issued 19 Oct. 1971 5 p Filed 7 Aug. 1970 Supersedes N70-41977 (08-24, p 4493)
(NASA-Case-MFS-20829; US-Patent-3,613,794; US-Patent-Appl-SN-61894; US-Patent-Class-169-28; US-Patent-Class-169-36) Avail: US Patent Office CSCL 20D

A liquid aerosol dispenser is described having an explosively driven piston that compresses a light gas to an extremely high pressure, so as to rupture a first sealer on a container holding the liquid, to allow admixing of the gas and the liquid. The container has a number of discharge nozzles covered with a rupturable sealer and upon rupture of the first sealer and admixing of the light gas and liquid, the sealer covering the nozzles is ruptured so as to allow the liquid to be expelled through the nozzles at a very high velocity in extremely fine droplet form. Official Gazette of the U.S. Patent Office

**N72-21311*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**MOMENTUM FLUX IN TWO PHASE TWO COMPONENT LOW QUALITY FLOW**
Kenneth J. Baumeister, Robert W. Graham, and Robert E. Henry (ANL) 1972 23 p refs Proposed for presentation at 13th Natl. Heat Transfer Conf., Denver, 6-11 Aug. 1972; sponsored by Am. Inst. of Chem. Engr. and ASME
(NASA-TM-X-68038; E-6871) Avail: NTIS CSCL 20D

In two phase flow systems line losses comprise frictional and momentum pressure drops. For design purposes, it would be desirable to estimate the line losses employing a one-dimensional calculation. Two methods for computing one-dimensional momentum flux at a test section discharge station are compared to the experimental value for a range of two-phase flow conditions. The one-dimensional homogeneous model appears to be more accurate generally in predicting the momentum than the variable slip model. Author

**N72-21312*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**COMPUTER PROGRAM FOR SOLVING COMPRESSIBLE NONSIMILAR-BOUNDARY-LAYER EQUATIONS FOR LAMINAR, TRANSITIONAL, OR TURBULENT FLOWS OF A PERFECT GAS**
Joseph M. Price and Julius F. Harris Washington Apr. 1972 116 p refs
(NASA-TM-X-2458; L-8037) Avail: NTIS CSCL 20D

A computer program is described which solves the compressible laminar, transitional, or turbulent boundary-layer equations for planar or axisymmetric flows. Three-point implicit difference relations are used to reduce the momentum and energy equations to finite-difference form. These equations are solved simultaneously without iteration. Turbulent flow is treated by the inclusion of either a two-layer eddy-viscosity model or a mixing-length formulation. The eddy conductivity is related to the eddy viscosity through a static turbulent Prandtl number which

may be an arbitrary function of the distance from the wall boundary. The transitional boundary layer is treated by the inclusion of an intermittency function which modifies the fully turbulent model. The laminar-boundary-layer equations are recovered when the intermittency is zero, and the fully turbulent equations are solved when the intermittency is unity. Author

**N72-21313*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**PITOT-PROBE DISPLACEMENT IN A SUPERSONIC TURBULENT BOUNDARY LAYER**

Jerry M. Allen Washington Apr. 1972 31 p refs

(NASA-TN-D-6759; L-8159) Avail: NTIS CSCL 20D

Eight circular pitot probes ranging in size from 2 to 70 percent of the boundary-layer thickness were tested to provide experimental probe displacement results in a two-dimensional turbulent boundary layer at a nominal free-stream Mach number of 2 and unit Reynolds number of 8 million per meter. The displacement obtained in the study was larger than that reported by previous investigators in either an incompressible turbulent boundary layer or a supersonic laminar boundary layer. The large probes indicated distorted Mach number profiles, probably due to separation. When the probes were small enough to cause no appreciable distortion, the displacement was constant over most of the boundary layer. The displacement in the near-wall region decreased to negative displacement in some cases. This near-wall region was found to extend to about one probe diameter from the test surface. Author

**N72-21314#** Cambridge Univ. (England).

**HIGH VELOCITY LIQUID IMPACT AND CAVITATION STUDIES**

J. E. Field 1971 15 p refs Presented at IUTAM Symp. on Non-steady Flow of Water at High Speeds, Leningrad, Jun. 1971 Avail: NTIS

Studies of high speed liquid impact and cavitation are summarized. The effects of rain erosion on airframes, propellers, rotary wings, and turbine blades are discussed. It was determined that under certain circumstances a collapsing cavity involutes and forms high speed jets. The effects of cavitation damage on ships and hydrofoils which serve to limit the speed of such vehicles through the water is examined. The behavior of many materials under the stress of water impact and cavitation is described. Mathematical models are included to support the theoretical aspects. Author

**N72-21315#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Reaktionskinetik.

**MEASUREMENTS COMPARING THE EXCITATION OF VIBRATIONAL ENERGY OF CO BEHIND SHOCK WAVES AND THE DE-EXCITATION OF VIBRATIONAL ENERGY IN EXPANSION WAVES**

P. Roth 27 Jul. 1971 139 p refs In GERMAN; ENGLISH summary

(DLR-FB-71-62) Avail: NTIS; DFVLR Porz-Wahn: 39,50DM

The vibrational relaxation of gaseous mixtures containing CO and Ar was investigated using rapid heating and rapid cooling rates. It was found that the relaxation process in both cases can be described satifactorily by the LANDAU-TELLER-equation. In the investigated temperature range of 1900 to 2900 K, it was shown that the relaxation time did not depend on the temperature or density gradient of the flow. This experimental result was confirmed by some model computations assuming rapid cooling of a gas consisting of anharmonic oscillators. Author

**N72-21316#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Arbeitsgruppe Thermoelastik.

**COMPARISON OF RESULTS OBTAINED FOR THE PROBLEM OF SYMMETRIC FLUID OSCILLATIONS IN TANKS BY THE FINITE DIFFERENCES TECHNIQUE AND THE FINITE ELEMENT METHOD**

K. Schiffner 12 Aug. 1971 61 p refs In GERMAN; ENGLISH summary

(DLR-FB-71-69) Avail: NTIS; DFVLR, Porz-Wahn: 18,70 DM

The problem of symmetric fluid oscillations in axisymmetric tanks is solved by using both finite differences technique and finite element method. In order to get comparable computer times an equal number of nodes and the same bandwidth of matrices are required for both methods. Since these conditions make possible a one order higher approximation of the finite differences equations than for displacement functions of finite elements, the method of finite differences results in a better approach of the eigenvalue problem than the finite element method. Author

**N72-21317#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).

**AN IMPLICIT FINITE-DIFFERENCE SCHEME FOR THE CALCULATION OF HYPERSONIC SLIPFLOW BOUNDARY LAYERS**

E. H. Hirschel 8 Dec. 1971 84 p refs In GERMAN; ENGLISH summary

(DLR-FB-71-97) Avail: NTIS; DFVLR Porz-Wahn: 23 DM

An implicit finite difference scheme for the numerical integration of the governing equations of hypersonic slipflow-boundary layers is presented. Derivations are given for the matrix elements of the solution and for the recursion relations of the algorithm. The calculation of the slipflow-boundary conditions, which are given as differential equations, is described along with the technique of decoupling the momentum equations and the energy equation from the continuity equation. A detailed description of the FORTRAN 4-machine program, the listing, the flow chart, and a sample calculation for the purpose of program testing are included. Author

**N72-21318#** California Univ., Livermore. Lawrence Radiation Lab.

**CONSIDERATION OF A SUPERSONIC JET AS A BEAM NEUTRALIZER**

John O. Myall 6 Jul. 1971 23 p refs

(Contract W-7405-eng-48)

(UCRL-51089) Avail: NTIS

The behavior of supersonic jets is described and analyzed and calculations for water vapor and for nitrogen are presented. The advantages and disadvantages of such jets are displayed so that their suitability for beam neutralization can be properly judged. Author

**N72-21319#** Los Alamos Scientific Lab., N.Mex.

**SOME PRELIMINARY NUMERICAL STUDIES OF TAYLOR INSTABILITY WHICH INCLUDE EFFECTS OF MATERIAL STRENGTH**

K. A. Meyer and P. J. Blewett Aug. 1971 9 p refs

(Contract W-7405-eng-36)

(LA-4754) Avail: NTIS

In this numerical study a two-dimensional Lagrangian code, TOODY II, is used to compute the growth of a perturbed interface between a perfect gas and an aluminum plate. The interface undergoes acceleration in the direction of the gas to the aluminum. Using an elastic perfectly plastic model for the aluminum the effects of yield strength, density ratio, wavelength, initial amplitude, and the elastic shear modulus on the perturbation growth rate are presented. Results are compared with Taylor theory and an attempt is made to develop an analytic expression for the effect of yield strength. Author (NSA)

**N72-21320#** Southeastern Massachusetts Univ., North Dartmouth.

**TORPEDO DRAG REDUCTION USING MAGNETO-HYDRODYNAMIC BOUNDARY LAYER CONTROL Final Report**

Y. K. Wu and G. F. Anderson Jan. 1972 30 p refs
(Contract N00140-69-C-0338)
(AD-735471) Avail: NTIS CSCL 19/8

Study for the drag reduction effect by use of MHD boundary-layer control had been carried out by the present investigators, with the assumption of non-zero electric field. The momentum integral method was used to obtain an optimum magnetic field distribution which would maintain a laminar boundary layer. The best solution to the drag reduction problem may be obtained by combining noise-free magnetohydrodynamic boundary-layer control, and suction and/or injection of ferromagnetic fluid. With this application in mind, two-dimensional magnetohydrodynamic boundary-layer flow with suction or injection is studied. Author (GRA)

**N72-21321#** Case Western Reserve Univ., Cleveland, Ohio. Div. of Fluid Thermal and Aerospace Sciences.

**EFFECT OF SWIRL ON CONICAL DIFFUSER PERFORMANCE**

Arbind Prasad and Simon Strach 20 Aug. 1971 80 p refs
(Grant AF-AFOSR-1485-68; AF Proj. 9781)
(AD-735383; FTAS/TR-71-67; AFOSR-71-2366TR) Avail: NTIS CSCL 20/4

The report deals with an experimental investigation of the effect of swirl on conical diffuser performance. Data on the gross performance of conical diffusers are reported. The effect of swirl on the separation phenomena in a conical diffuser has been studied. Success has been achieved in avoiding the separation completely through swirl in conical diffusers of a divergence angle as large as 35 degrees. An optimum swirl angle has been found for each diffuser. Turbulence level measurements are taken and they indicate that turbulence is not a dominant factor in eliminating separation. Author (GRA)

**N72-21322#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**SCIENTIFIC NOTES OF THE CENTRAL AEROHYDRODYNAMIC INSTITUTE (TsAGI)**

B. A. Ilin, A. A. Nikolskii, V. I. Kireev, V. Ya. Neiland, and V. N. Gusev 21 Oct. 1971 243 p refs Transl. into ENGLISH from Uch. Zap. Tsentr. Aerogidrodinamicheskii inst. (USSR), v. 1, no. 1, 1970 p 1-161
(AD-735604; FTD-HT-23-991-71) Avail: NTIS CSCL 20/4

The author indicates limit transitions under which the law of plane cross-sections becomes asymptotically correct, enabling us to reduce the problem of three-dimensional stationary detached flow to a problem of two-dimensional nonstationary detached flows about flat bodies. Within the bounds of applicability of the law of plane cross-sections, the author determines general and special laws of similarity for a stationary three-dimensional flow. Specifically, for a rectangular plate of a very low aspect ratio with flow under the angle of attack, we obtain limiting law of similitude. Author (GRA)

**N72-21323#** Minnesota Univ., Minneapolis. Dept. of Aerospace Engineering and Mechanics.

**POWER SERIES SOLUTIONS FOR FLOWS OF AN IDEAL DISSOCIATING GAS Final Report, 1 Jan. 1969 - 15 Sep. 1971**

John P. Moran and Chong Wong Lee 15 Sep. 1971 82 p refs
(Contract DAHC04-69-C-0031)
(AD-735697; AROD-8127-2-E) Avail: NTIS CSCL 20/4

The report deals with the solution of certain problems in fluid mechanics by power-series expansion of the solution in the independent variable(s). The method is directly related to the well-known Frobenius method for determining analytic solutions of linear ordinary differential equations. However, here the authors apply it to nonlinear systems of differential equations in as many as three independent variables. In consequence, the recursion formulas for the series coefficients are relatively complicated, and an electronic computer is required to effect and to store their solution. Author (GRA)

**N72-21324#** Naval Ordnance Lab., White Oak, Md. Underwater Explosions Div.

**FINITE AMPLITUDE PROPAGATION OF AN UNDERWATER EXPLOSION SHOCK WAVE ALONG A STRONGLY REFRACTED RAY TUBE**

John F. Goertner 1 Dec. 1971 31 p refs
(AD-735875; NOLTR-71-139) Avail: NTIS CSCL 19/4

The effect of wave overtaking on the peak pressure of refracted underwater explosion shock waves is estimated by means of a finite amplitude calculation for the wave propagation along refracted ray tubes given by simple ray theory. The results indicate that a reduction in peak pressure occurs due to increased wave-overtaking along refracted ray paths to first caustics. Reductions in the peak pressure no greater than 5% occurred for the particular refractive conditions treated, but preliminary work with other conditions indicates much greater reductions can occur. Author (GRA)

**N72-21325#** Harry Diamond Labs., Washington, D.C.

**FLUERICS 31. THE TRANSITION FROM ISOTHERMAL TO ADIABATIC CAPACITANCE IN CYLINDRICAL ENCLOSURES**

Silas Katz and Edgar Hastie Dec. 1971 31 p refs
(AD-735704; HDL-TM-71-35) Avail: NTIS CSCL 13/7

The capacitance of enclosed volumes depends on the polytropic exponent. The relation between this exponent, frequency, and tank size is calculated for cylindrical enclosures from Daniels' acoustic theory. Daniels' solution is also used to find an average polytropic exponent for fluid capacitive circuits subjected to rectangular pulses of up to 8-sec duration. Frequency response tes' with finite amplitude are performed on fluid RCR circuits to determine the correspondence between the theory and the capacitance measured on lumped parameter circuits. The calculated data fall within 20 percent of the theory for circuits without through-flow. Tests with small amounts of through-flow show only slight differences. The tendency is for through-flow to maintain isothermal conditions at frequencies above those that occur without through-flow. Author (GRA)

**N72-21326#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

**ON THE ATTENUATION OF DIVERGING WAVES IN A POROUS MATERIAL**

Peter J. Torvik Nov. 1971 49 p refs
(AD-735761; AFIT-TR-71-4) Avail: NTIS CSCL 19/4

Several approximate theories for predicting the attenuation rate of shockwaves in porous materials are developed. The material is assumed to be an ideal locking solid. Cylindrical and Spherical geometries are considered, with the shockwave assumed to be generated by several different mechanisms, including the instantaneous deposition of momentum and the rapid deposition of energy over the interior of a cavity in the porous material. The generation of shockwaves through the adiabatic expansion of a cavity filled with an ideal gas at high pressure is also considered with a model based on conservation of momentum and a model based on conservation of energy. The predictions of six simple models are compared for the case of a cylindrical wave in a material having low porosity, including a model which is analagous to the familiar 'snowplow' model. Author (GRA)

**N72-21327#** Stanford Univ., Calif. Dept. of Mathematics.

**ACOUSTICAL DIFFRACTION RADIATION**

Harold Levine 17 Dec. 1971 51 p refs
(Contract N00014-67-A-0112-0048)
(AD-735922; SU-TR-18) Avail: NTIS CSCL 20/4

A finite region of turbulent flow is represented by a volume distribution of quadrupolar sources, according to the Lighthill model, for the purpose of estimating the sound level generated in the surrounding region. By way of incorporating environmental features into such a model of free turbulence it becomes appropriate to examine quadrupolar source interaction with material surfaces; this poses a formidable diffraction or scattering problem unless the surface is compact on the acoustic wave

length scale or of simple geometrical shape. The calculations by Ffowcs Williams and Hall (1970), Crighton and Leppington (1971) relative to an immobile point quadrupole near the straight edge of a thin semi-infinite plane screen, which bring out the possibility of a substantial amplification in the far field as the result of scattering by the screen, suggest a related rise for the output level of an actual flow in a comparable setting; and they prompt the consideration of acoustical effects attributable to the motion of sources past the edge. Author (GRA)

**N72-21328#** Raytheon Co., Sudbury, Mass. Equipment Development Labs.
**RAY TRACING SYNTHESIS OF HF RADAR SIGNATURES FROM GAUSSIAN PLASMA CLOUDS**
Pendyala B. Rao, E. Michael Allen, and George D. Thome Mar. 1971 105 p refs
(Contract F30602-68-C-0299; ARPA Order 1057)
(AD-736040; RADC-TR-71-313; TR-3) Avail: NTIS CSCL 04/1

The electron density distribution through ionized clouds produced by varium releases is often taken to be Gaussian for want of direct evidence to the contrary. Multiple frequency HF radar observations (scattering cross-section and Doppler shift versus time) have been made during several releases for the primary purpose of measuring peak electron density as a function of time. Observations of this sort cannot be used to compute the electron density distribution directly because the cloud elongates along the earth's magnetic field and thus the distribution is not one-dimensional. These observations can however be used to test assumed distributions by ray tracing through a model cloud and comparing the predicted signatures with the observations. A detailed comparison of this nature has been made using a time-dependent Gaussian cloud and the ITSA three-dimensional ray tracing program. Author (GRA)

# 13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

**N72-21329** Ceskoslovenska Akademie Ved, Prague.
**UPPER MANTLE PROJECT PROGRAMME IN CZECHOSLOVAKIA 1962 - 1970: GEOPHYSICS**
1971 185 p refs
Copyright. Avail: Issuing Activity

Papers are presented on the structure, composition, and dynamics of the earth crust and upper mantle. Gravity anomalies and variations, seismic sounding and models, crustal movements, electrical conductivity of the earth, and paleomagnetic research are included. For individual titles, see N72-21330 through N72-21348.

**N72-21330** Ceskoslovenska Akademie Ved, Prague. Geophysical Inst.
**INVESTIGATION OF TIDES OF THE EARTH'S CRUST**
Jan Picha *In its* Upper Mantle Proj. Programme in Czechoslovakia 1962 - 1970: Geophys. 1971 p 8-12 refs (See N72-21329 12-13)
Copyright. Avail: Issuing Activity

The establishment of pendulums and inclinometers in mines for observing earth tides is described, and initial measurements are discussed. Problems encountered with the accuracy of the instruments and various methods of harmonic analysis of tidal observations are emphasized. Two of the stations are located in deep mines where rock bursts are frequent. Free oscillations of the earth after the Alaskan earthquake of 28 March 1964 are also mentioned. N.E.N.

**N72-21331** Kosice Univ. (Czechoslovakia).
**ON SOME METHODS OF INTERPRETING GRAVITY ANOMALIES**
Tibor Kolbenheyer *In* Czech. Acad. Sci. Upper Mantle Proj. Programme in Czechoslavakia 1962 - 1970: Geophys. 1971 p 13-18 refs (See N72-21329 12-13)
Copyright. Avail: Issuing Activity

Several methods of interpreting gravity anomalies, developed during 1962 and 1970, are described. Procedures in computing the gravitational fields of three-dimensional and two-dimensional bodies using surface and curvilinear integrals are emphasized. Illustrations are given for a vertical prism or cylinder, rectangular prism, and various polygons. N.E.N.

**N72-21332** Ceskoslovenska Akademie Ved, Prague. Geophysical Inst.
**ON THE COMPUTATION OF THE GRAVITY TERRAIN CORRECTION IN CZECHOSLAVAKIA**
Milos Pick *In its* Upper Mantle Proj. Programme in Czechoslavakia 1962 - 1970: Geophys. 1971 p 19-22 refs (See N72-21329 12-13)
Copyright. Avail: Issuing Activity

Formulas are given for computing the gravity terrain corrections inside and outside a circle with a radius of 5.26 km. The correction term for the outer masses has a functional dependence on the local or inner term, sea heights, and geographical coordinates. It can be represented and computed graphically. The correction factor for the inner area has to be determined for every gravity point individually. Mathematical models were selected to yield a final accuracy of the gravity terrain correction of + or - 0.2 mgal. N.E.N.

**N72-21333** Research Inst. of Geodesy, Prague (Czechoslovakia).
**SATELLITE GRAVITY STUDIES**
Milan Bursa *In* Czech. Acad. Sci. Upper Mantle Proj. Programme in Czechoslavakia 1962 - 1970: Geophys. 1971 p 23-39 refs (See N72-21329 12-13)
Copyright. Avail: Issuing Activity

Tabulated and mapped geoid data based on satellite observations are presented. These include geoid heights, deflections of the vertical, gravity over equipotential surfaces, best fitting ellipses for various sections, differences in the structure of the gravity field in the Northern and Southern Hemispheres, and differences in the mean values of gravity determined from satellite and from terrestrial data. N.E.N.

**N72-21334** Ceskoslovenska Akademie Ved, Prague. Geophysical Inst.
**CORRELATION ANALYSIS OF GRAVITY ANOMALIES AND ISOSTASY**
Vincenc Vyskocil *In its* Upper Mantle Proj. Programme in Czechoslavakia 1962 - 1970: Geophys. 1971 p 40-46 refs (See N72-21329 12-13)
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The correlation between gravity anomalies and heights above sea level of the terrain was studied for sections of Czechoslovakia. It was found that for Czechoslovakia, as for other parts of the world, the free-air anomalies display a marked positive value of the correlation coefficient but the Bouguer anomalies display a marked negative value. The results are considered to prove the existence of isostatic compensation of the topographic masses. Investigations in applying the theory of homogeneous random fields to the treatment and interpretation of gravity and other geophysical fields are reviewed. N.E.N.

**N72-21335** Ceskoslovenska Akademie Ved, Brno. Inst. of Applied Geophysics.
**GRAVITY ANOMALIES AND THE STRUCTURE OF THE EARTH'S CRUST ON THE TERRITORY OF CZECHOSLOVAKIA**
Jaroslav Ibrmajer *In its* Upper Mantle Proj. Programme in Czechoslavakia 1962 - 1970: Geophys. 1971 p 47-50 refs

(See N72-21329 12-13)
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Regional and overall studies of gravity anomalies in the Bohemian Massif and West Carpathians are reviewed. The differences between the gravity fields in the two locations are described, and massifs are usually found to cause negative anomalies. The effect of isostasy in the West Carpathians is also mentioned. N.E.N.

**N72-21336** Research Inst. of Geodesy, Prague (Czechoslovakia).
**POLYGONS FOR STUDYING THE SECULAR VARIATIONS OF THE ACCELERATION OF GRAVITY ON THE TERRITORY OF CZECHOSLAVAKIA**
Zdenek Simon and Lubomir Traeger (Geodetic Inst., Prague) *In* Czech. Acad. Sci. Upper Mantle Proj. Programme in Czechoslavakia 1962 - 1970: Geophys. 1971 p 51-53 ref (See N72-21329 12-13)
Copyright. Avail: Issuing Activity

The establishment of two secular gravimetric polygons for investigating gravity field variations are reported. One polygon extends from Cheb in the westernmost part of Czechoslovakia to Kamenica n. Cir near the eastern border. The other polygon runs north-south in the regions of intense vertical rise in North Slovakia and Nove Zamky. Three gravimeters were used, and meteorological measurements were carried out simultaneously. Random and semisystematic errors are discussed. N.E.N.

**N72-21337** Ceskoslovenska Akademie Ved, Prague. Geophysical Inst.
**CRUSTAL AND UPPER MANTLE SEISMIC ACTIVITY IN THE EUROPEAN AREA, 2**
Vit Karnik *In its* Upper Mantle Proj. Programme in Czechoslavakia 1962 - 1970: Geophys. 1971 p 54-68 refs (See N72-21329 12-13)
Copyright. Avail: Issuing Activity

Research on earthquakes, their magnitudes and regions is summarized. Problems associated with determining the magnitude-frequency relation are described. The thresholds values of minimum and maximum magnitudes are considered, along with probability distributions for maximum shocks. The most active regions are the North Anatolian fault zone and the area from the central part of the Atlantic Ridge to Gibraltar. Laboratory detection of elastic waves in rock subjected to uniaxial compression is described, and the statistical properties analogous to those in seismology are discussed. N.E.N.

**N72-21338** Ceskoslovenska Akademie Ved, Prague. Geophysical Inst.
**AMPLITUDE CURVES OF SEISMIC BODY WAVES AND THE STRUCTURE OF THE UPPER MANTLE**
Jiri Vanek *In its* Upper Mantle Proj. Programme in Czechoslavakia 1962 - 1970: Geophys. 1971 p 69-74 refs (See N72-21329 12-13)
Copyright. Avail: Issuing Activity

The amplitude vs epicenter distance curves, based on earthquake magnitude and including the amplitude oscillations, were used to determine the upper mantle structure for Southeastern Europe. The main characteristics of the upper mantle are a low-velocity channel at about 100 km depth and a discontinuity at about 400 km. Other discontinuities are noted. Comparison of the Southeastern European and Central Asian upper mantles suggests that the actual structure is more complicated than the Bullen model and that the main lateral variations can be expected in the region between the Mohorovicic discontinutity and the upper boundary of the low-velocity channel. N.E.N.

**N72-21339** Ceskoslovenska Akademie Ved, Prague. Geophysical Inst.
**THREE DIMENSIONAL SEISMIC MODELS OF THE UPPER MANTLE**
Jiri Vanek *In its* Upper Mantle Proj. Programme in Czechoslavakia 1962 - 1970: Geophys. 1971 p 75-78 refs (See N72-21329 12-13)
Copyright. Avail: Issuing Activity

A three-dimensional model is described which contains a large number of thin horizontal layers to produce a continuous variation of wave velocity. Multicomponent gels were tried, and a water-glycerol-gelatine system was chosen. Velocity data, amplitude curves, and the wave field for the model are given. N.E.N.

**N72-21340** Ceskoslovenska Akademie Ved, Prague. Geophysical Inst.
**PHYSICAL PARAMETERS OF ROCKS**
Jiri Vanek *In its* Upper Mantle Proj. Programme in Czechoslavakia 1962 - 1970: Geophys. 1971 p 79-84 refs (See N72-21329 12-13)
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Investigations of elastic wave propagation, gamma ray absorption, and thermal conductivity in rocks are reviewed. Laboratory measurements were made of the elastic wave velocity and attenuation variations in rocks under high pressures, and it was found that the Poisson ratio does not always increase with increasing pressure. Gamma ray absorption was studied at 0.66 MeV and 1.25 MeV in connection with density measurements. Thermal conductivity of several hundred rock samples is reported. N.E.N.

**N72-21341** Ceskoslovenska Akademie Ved, Prague. Geophysical Inst.
**RESEARCH INTO THEORY OF SEISMIC WAVES**
Vlastislav Cerveny (Charles Univ.), Karel Pec (Charles Univ.), and Karel Klima *In its* Upper Mantle Proj. Programme in Czechoslavakia 1962 - 1970: Geophys. 1971 p 85-93 refs (See N72-21329 12-13)
Copyright. Avail: Issuing Activity

Computer programming considerations for interpreting and processing of seismic data related to the earth crust and upper mantle are presented. Travel-time curves of waves propagating in the earth crust are discussed and various programs for calculating their properties are mentioned. Partial derivatives of phase and group velocities were computed, and the dispersion of Love waves propagating in a wedge and in a single layer was investigated. Programs were written for frequency analysis based on a numerical evaluation of Fourier integrals, and the effect of errors in the digitizing process on amplitude spectra and short period vertical P wave spectra were calculated. Approximate, exact, and finite difference methods were used to find amplitude and spectral properties of seismic waves. N.E.N.

**N72-21342** Ceskoslovenska Akademie Ved, Prague. Geophysical Inst.
**RESULTS OF DEEP SEISMIC SOUNDING IN CZECHOSLOVAKIA**
Bretislav Beranek, Milada Zounkova, and Karel Holub *In its* Upper Mantle Proj. Programme in Czechoslavakia 1962 - 1970: Geophys. 1971 p 94-115 refs (See N72-21329 12-13)
Copyright. Avail: Issuing Activity

Measurements along international profile 6 are described in detail, and preliminary results along profiles 5 and 7 are given. Profile 6 from the Bohemian Massif into the region of the West Carpathian system, and over into the Pannonian Massif. Both deep seismic sounding data and natural seismic noise were recorded. The complicated nature of the seismographs are discussed, and the main groups of waves are distinguished. Average velocities vs depths were computed for the Bohemian Massif and the Carpathian system and depth sections are presented. Travel-time curves are given for profiles 5 and 7, and the crust thickness is described. N.E.N.

**N72-21343** Research Inst. of Geodesy, Prague (Czechoslovakia).
**RECENT CRUSTAL MOVEMENTS IN CZECHOSLAVAKIA**
Milos Cimbalnik and Pavel Vyskocil *In* Czech. Acad. Sci. Upper

Mantle Proj. Programme in Czechoslavakia 1962 - 1970: Geophys. 1971 p 116-119 refs (See N72-21329 12-13)
Copyright. Avail: Issuing Activity

Research on short-period crustal movements at Lisov stationary polygon is briefly reported. It was found that short-period motions display an annual period with a relative amplitude of 7 mm maximum. The differences in leveling and the overall tendency of the motion are illustrated. N.E.N.

**N72-21344** Ceskoslovenska Akademie Ved, Prague. Geophysical Inst.
**DETERMINATION OF THE FIGURE OF THE EARTH**
Milos Pick *In its* Upper Mantle Proj. Programme in Czechoslavakia 1962 - 1970: Geophys. 1971 p 120-121 refs (See N72-21329 12-13)
Copyright. Avail: Issuing Activity

Research on the figure of the earth is briefly reviewed. Substitution of the earth by a mathematical model or reference body, transformation of one reference system to another, computations required if the rotational axes of the bodies are not parallel, and the theory of normal heights are mentioned. N.E.N.

**N72-21345** Ceskoslovenska Akademie Ved, Prague. Geophysical Inst.
**CHECK OF MOLODENSKII'S METHOD ON MATHEMATICAL MODELS AND IN TEST AREAS**
Milos Pick *In its* Upper Mantle Proj. Programme in Czechoslavakia 1962 - 1970: Geophys. 1971 p 122-134 refs (See N72-21329 12-13)
Copyright. Avail: Issuing Activity

Molodenskii's method of determining the figure of the earth is analyzed and applied to the test areas of the High Tatras, the High Fatras, and the West Alps. Modifications to include slopes greater than 45 deg are mentioned and various methods of approximate integration are mentioned. In the West Alps the figure of the earth was computed considering the effect of the area within 100 km, between 100 and 1620 km, and beyond. Deflections of the vertical were determined using free-air anomalies and by elimination of topographical masses; both methods gave the same accuracy. Errors in topographical corrections, heights above sea level, and gravity anomalies are considered. N.E.N.

**N72-21346** Research Inst. of Geodesy, Prague (Czechoslovakia).
**CORRELATION BETWEEN DEFLECTIONS OF THE VERTICAL AND THE AXES OF ZONES OF INCREASED MACROSEISMIC MOBILITY**
Milan Bursa *In* Czech. Acad. Sci. Upper Mantle Proj. Programme in Czechoslavakia 1962 - 1972: Geophys. 1971 p 135-139 refs (See N72-21329 12-13)
Copyright. Avail: Issuing Activity

The components of the deflections of the vertical were determined for over 1000 points in Czechoslovakia using astrogeodetic and gravity data. The deflections of the vertical after removal of the topographical masses show a relation to the axes of the zones of increased macroseismic mobility. The axes of the zones also agree with the principal tectonic dislocation lines. Maps and graphs of the data are included. N.E.N.

**N72-21347** Ceskoslovenska Akademie Ved, Prague. Geophysical Inst.
**DISTRIBUTION AND DYNAMICS OF THE GEOMAGNETIC FIELD BASED ON PALEOMAGNETIC STUDIES AND ANALYSES OF SECULAR VARIATION: THEORETICAL STUDY OF GEOMAGNETIC FIELD MODELS**
Vaclav Bucha *In its* Upper Mantle Proj. Programme in Czechoslavakia 1962 - 1970: Geophys. 1971 p 140-161 refs (See N72-21329 12-13)
Copyright. Avail: Issuing Activity

Paleomagnetic and archeomagnetic research, and studies of magnetism in minerals and rocks are discussed. Polar wandering, polar reversals, and geomagnetic intensity and moment variations are described. Magnetic properties of minerals of the spinel group, basalts from the Bohemian Massif, mica-schists from the As area, and amphibolites of west Moravia were determined. The distribution and changes in the geomagnetic field in Central Europe were studied, and the most expressive anomalies were found in southeast Moravia and northeast Poland. Geomagnetic field models are also considered, and the best agreement was achieved with models in which the geomagnetic moment is in the direction of the earth's axis of rotation. N.E.N.

**N72-21348** Ceskoslovenska Akademie Ved, Prague. Geophysical Inst.
**ELECTRIC CONDUCTIVITY OF THE EARTH IN CZECHOSLOVAKIA STUDIED BY MAGNETOTELLURIC AND GEOMAGNETIC METHODS**
Oldrich Praus *In its* Upper Mantle Proj. Programme in Czechoslavakia 1962 - 1970: Geophys. 1971 p 162-186 refs (See N72-21329 12-13)
Copyright. Avail: Issuing Activity

Electrical conductivity of the earth crust and upper mantle were determined as a function of the depth below the earth's surface, and the magnetotelluric field was studied using models of an anisotropic or horizontally inhomogeneous earth. Magnetotelluric and geomagnetic sounding data are described, and apparent resistivity curves are included. The directional properties of the electrical conductivity were measured and the impedance tensor elements were estimated. A laboratory study of the temperature and pressure effects on the electrical conductivity of rocks is also reported. N.E.N

**N72-21349** National Lending Library for Science and Technology, Boston Spa (England).
**MEASUREMENT OF THE ABSORPTION COEFFICIENT IN THE ATMOSPHERE AT WAVELENGTH OF LAMBDA EQUALS 5.28 - 20 cm**
D. A. Dmitrenko and L. V. Vinogradova [1970] 12 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Moscow), no. 13, 1970 p 1761-1768
(NLL-M-22050-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Experiments were conducted to determine the value of the absorption coefficient in the short wave region of the decimeter range (lambda < 20 cm). Operation of the antenna used for the experiments is discussed. K.P.D.

**N72-21350** National Lending Library for Science and Technology, Boston Spa (England).
**NATURE OBSERVATION: A NO. 1 PROBLEM**
D. Kumari [1971] 5 p Transl. into ENGLISH from the Estonian
(NLL-M-22220-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The problems of utilizing and protecting the resources of the biosphere are considered. Their investigation in Estonia is discussed, in particular. K.P.D.

**N72-21351** National Lending Library for Science and Technology, Boston Spa (England).
**THE SUN-ATMOSPHERE EXPERIMENT**
[1971] 3 p refs Transl. into ENGLISH from the Russian report (NLL-M-22221-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

An experiment was conducted to study the influence of a solar flare on the earth's atmosphere. Data obtained include corpuscular beam records, electron concentration, ionic composition of the atmosphere and its density, pressure variations, winds, and rate of photochemical reactions in the entire vertical thickness of the atmosphere. K.P.D.

**N72-21352** National Lending Library for Science and Technology, Boston Spa (England).
**SPECTRA OF THE ABSORPTION OF ATMOSPHERIC**

**GASES IN VACUUM ULTRAVIOLET REGIONS**
V. P. Bielozerova [1971] 5 p Transl. into ENGLISH from Obzor (Poland) p 53-54 In ENGLISH and RUSSIAN
(NLL-M-22123-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Absorption spectra measurements of water vapor, carbon monoxide, and carbon dioxide are considered for vacuum ultraviolet regions in the atmosphere. K.P.D.

**N72-21353** National Lending Library for Science and Technology, Boston Spa (England).
**INERTIAL GRAVITY WAVES AND MESO-SCALE WIND STRUCTURE IN JET STREAMS**
N. P. Sakina and T. P. Kapitanova [1971] 14 p refs Transl. into ENGLISH from Glav. Uprav. Gidromet. Sluzh., Met. Gidr. (Leningrad), no. 1, 1971 p 32-41
(NLL-M-22060-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The problem of meso-scale waves in a jet stream is considered, allowing for buoyancy forces and the coriolis force. The basic flow is assumed to be plane parallel and inviscid, and the wave distribances small. Phase velocities and amplitude functions of neutral nonsingular waves (overtaking the flow or moving into it) were found by the method of successive approximations. The dependence of the values found on the form of the disturbances, the wavelength, the stability, and the effect of the earth's rotation are investigated. It is suggested that meso-scale inhomogeneities in the wind field in jet streams may be formed as an effect of waves of the gravity-inertial type.
Author

**N72-21354*#** California Univ., Los Angeles. Dept. of Physics.
**DAYSIDE AURORAL OVAL PLASMA DENSITY AND CONDUCTIVITY ENHANCEMENTS DUE TO MAGNETO-SHEATH ELECTRON PRECIPITATION**
C. F. Kennel and M. H. Rees (Colo. Univ., Boulder) Sep. 1971 19 p refs
(Grants NGR-05-007-190; NGR-05-007-116; Contracts N00014-69-A-0200-4023; AT(04-3)-34; Grant NSF GP-22817; NR Proj. 012-306)
(NASA-CR-125929; AD-730826; PPG-96) Avail: NTIS CSCL 04/1

By assuming that magnetosheath electrons are maintained as isotropic by strong pitch angle diffusion as they precipitate into the ionosphere, the precipitation heat flux may be simply related to solar wind energy density, and consequently to the level of magnetic activity. For quiet solar wind conditions, the 1 to 10 erg/sq cm -sec heat fluxes expected and observed lead to height-integrated Pedersen conductivity enhancements of 4 to 15 mhos. During magnetic storms, the conductivity enhancements could increase by a factor of 3 to 5. Since the precipitating electrons are soft, the Hall conductivity enhancements are smaller. Nevertheless, they lead to field-aligned currents bounding the oval in agreement with observations. Author

**N72-21355*#** Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
**ASTRONOMY IN THE REGION 1-0.1mm WAVELENGTHS Semiannual Report, 1 Jan. - 30 Sep. 1971**
Rainer Weiss 7 Feb. 1972 68 p refs
(Grant NGR-22-009-526)
(NASA-CR-125936) Avail: NTIS CSCL 04A

Measurements in five different passbands in the spectral region below 20/cm were made with a liquid helium-cooled radiometer in two flights at approximately 40 km altitude. The equivalent temperatures are given for passbands of 1 to 5.4, 7.8, 7.9, 11.1, and 18.5/cm. The results are consistent with a 2.7 K thermal radiation background. Atmospheric radiation of uncertain magnitude dominates the region above 11/cm. Author

**N72-21356*#** Stanford Univ., Calif. Remote Sensing Lab.
**INFRARED SPECTROMETRY STUDIES. PHASE 4: EMITTANCE SPECTRA OF SELECTED TARGETS FROM MISSION 108 AIRBORNE DATA Final Report C, 1 Oct. 1970 - 31 Sep. 1971**
R. J. P. Lyon 31 Oct. 1971 245 p refs
(Contract NAS9-7313)
(NASA-CR-115524; SU-RSL-71-6) Avail: NTIS CSCL 08G

Infrared radiance measurements from geological materials were studied. These involved laboratory and field spectroscopic measurements, both on the ground and airborne. A proven, feasible system is presented for airborne use over terrains with minimal vegetation. It has been shown that the spectral emittance concepts can be utilized in emittance ratio imagery which depicts the silicate composition of the terrain. Author

**N72-21357*#** Texas A&M Univ., College Station. Remote Sensing Center.
**REMOTE SENSING IN HYDROLOGY: A SURVEY OF APPLICATIONS WITH SELECTED BIBLIOGRAPHY AND ABSTRACTS**
Sidney W. Sers, comp. Oct. 1971 30 p refs
(Grant NGL-44-001-001)
(NASA-CR-126025; RSC-22) Avail: NTIS CSCL 08H

Remote infrared sensing as a water exploration technique is demonstrated. Various applications are described, demonstrating that infrared sensors can locate aquifers, geothermal water, water trapped by faults, springs and water in desert regions. The potentiality of airborne IR sensors as a water prospecting tool is considered. Also included is a selected bibliography with abstracts concentrating on those publications which will better acquaint the hydrologist with investigations using thermal remote sensors as applied to water exploration. Author

**N72-21358*#** Texas A&M Univ., College Station. Remote Sensing Center.
**A COMPARISON OF TWO APPROACHES FOR CATEGORY IDENTIFICATION AND CLASSIFICATION ANALYSIS FROM AN AGRICULTURAL SCENE**
J. A. Schell Mar. 1972 32 p refs Presented at the Space Inst. Conf. on Earth Resources Observations and Inform. Analysis Systems, Tenn. Univ., 1972
(Grant NGL-44-001-001)
(NASA-CR-126024; RSC-36) Avail: NTIS CSCL 08G

Supervised and unsupervised classification modes are discussed in light of the multidisciplinary, high data rate requirements of the ERTS satellites soon to be launched. Inadequacies of each system in light of these requirements are noted and a compromise solution to the data classification system is proposed. An example of results obtained with an implementation of this system are shown and compared with results from a supervised classification scheme. Author

**N72-21359*#** Scientific Translation Service, Santa Barbara, Calif.
**STUDY ON SAND MOVEMENT BY WIND**
R. Kawamura Washington NASA Apr. 1972 48 p refs Transl. into ENGLISH from Tokyo Daigaku Rikogaku Kenkyusho Hokoku (Tokyo), v. 5, no. 3-4, Oct. 1951 p 95-112
(Contract NASw-2035)
(NASA-TT-F-14215) Avail: NTIS CSCL 08M

The relation between the rate of sand flow and the friction velocity of the wind was derived, agreeing with experimental results of wind tunnel and field studies. The statistical treatments of the phenomena make possible the calculation of the vertical density distributions of sand particles and quantity of sand flow. It is shown that the mass of moving sand increases more rapidly in the lower layer than is predicted by ordinary diffusion theory.
Author

**N72-21360*#** Techtran Corp., Glen Burnie, Md.
**MOVEMENT OF WATER THROUGH THE SURFACE LAYERS OF THE SOIL**
M. J. Pouquet Washington NASA Apr. 1972 12 p refs Transl. into ENGLISH from Assoc. Geographes. France., Bull. de

Paris (Paris), no. 334-335, May-Jun. 1965 p 69-77
(Contract NASw-2037)
(NASA-TT-F-14247) Avail: NTIS CSCL 08M

It was observed that heating of the soil's surface causes downward movements to be amplified. Cooling sets off opposite phenomena. Applications are in the fields of agronomy, pedology, geology, geography, and civil engineering. Author

N72-21361*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**PARTIAL REFLECTIONS OF RADIO WAVES FROM THE LOWER IONOSPHERE**
Denis J. Connolly and Samuel B. Tanenbaum (Case Western Reserve Univ.) Washington Apr. 1972 50 p refs
(NASA-TN-D-6742; E-6701) Avail: NTIS CSCL 20N

The addition of phase difference measurements to partial reflection experiments is discussed, and some advantages of measuring electron density this way are pointed out. The additional information obtained reduces the requirement for an accurate predetermination of collision frequency. Calculations are also made to estimate the errors expected in partial-reflection experiments due to the assumption of Fresnel reflection and to the neglect of coupling between modes. In both cases, the errors are found to be of the same order as known errors in the measurements due to current instrumental limitations. Author

N72-21362# Bureau of Mines, Washington, D.C.
**MINES BUREAU SAYS SURFACE MINING MIGHT BE CHECKED FROM SPACE PHOTOGRAPHS News Release**
Bender 12 Apr. 1972 2 p ref
Avail: Issuing Activity

The use of satellite photographs for monitoring mining operations is proposed. Open pit copper mining data were obtained from photographs taken by Gemini 5, Apollo 6, and Apollo 9 flights. Photointerpretation procedures to idenity solid waste disposal and mined land mined land restoration activities are described. The application of spaceborne photography as a method for solving environmental problems is recommended. Author

N72-21363# Royal Aircraft Establishment, Farnborough (England).
**ON THE SPECTRA OF WIND DRIVEN WAVES AT SMALL FETCHES**
G. E. Kononkova, E. A. Nikitina, L. V. Poborchaya, and A. A. Speranskaya 14 Jan. 1972 14 p refs Transl. into ENGLISH from Fiz. Atm. Okfana (USSR), v. 6, no. 7, 1970 p 747-751
(RAE-Lib-Trans-1634) Avail: NTIS

Investigations into the initial stages of wind wave development were made under laboratory conditions with low wind velocities over a small area of water. The wave height spectral distribution is shown not to be Gaussian, but a relation is established between the mean wave height and the dispersion of the wave ordinates. A qualitative relationship between wave height and distribution parameters, and the wind velocity is stated. For wave frequencies higher than those corresponding to maximum wave height, the spectral density is shown to be inversely proportional to the fifth power of the frequency. The nondimensional distance and nondimensional frequency of the maximum of spectral density are defined, and shown to have a substantially fixed relationship, independent of range length and wind speed. Author

N72-21364*# Translation Consultants, Ltd., Arlington, Va.
**INTERPRETATION OF AERIAL PHOTOGRAPHS FOR GEOMORPHOLOGICAL RESEARCH**
Ye. N. Azbukina Washington NASA Apr. 1972 86 p refs Transl. into ENGLISH of the book "Deshifrirovaniye Aerofotosnimkov dlya Geomorfologicheskikh Issledovaniy" Leningrad, Leningrad Univ. Press, 1969
(Contract NASw-2038)
(NASA-TT-F-624) Avail: NTIS CSCL 08G

The application of aerial photograph interpretation in field and office geomorphological research and photointerpretation is described. Relief types and forms, their origin, and interrelationships between the latter and geological structure are described. Aerial photographs of relief forms representative of the various landscape-geographical conditions in different regions in the Soviet Union are included. Author

N72-21365*# Columbia Univ., Palisades, N.Y.
**MODELS OF GRAVITY WAVE PERTURBATIONS OF THE NEUTRAL UPPER ATMOSPHERE OF THE EARTH**
Ganti L. Rao Washington NASA Apr. 1972 67 p refs
(Contract NAS8-27088)
(NASA-CR-2033) Avail: NTIS CSCL 08N

Observational data from an array of CW Doppler sounding stations were analyzed and traveling ionospheric disturbances (TID's) were identified and analyzed using spectral analysis techniques. Seasonal variations in frequency, direction, and speed of propagation of TID's were found, which could be explained as manifestations of internal acoustic gravity waves, where propagation was influenced by the thermodynamic structure of the mesosphere and lower thermosphere. Author

N72-21366# Miami Univ., Fla. Rosenstiel School of Marine and Atmospheric Sciences.
**U, Th, AND Pa ISOTOPES AS INDICATORS OF GEOLOGIC PROCESSES IN MARINE ENVIRONMENTS, PART 1 Annual Progress Report, Aug. 1970 - Aug. 1971**
Harold S. Rydell Aug. 1971 26 p refs
(Contract AT(40-1)-3622)
(ORO-3622-12-Pt-1) Avail: NTIS

From August 1970 to August 1971 several geochemical studies were initiated using Th and U isotopes as indicators of geological processes in the marine environment. Summaries are presented of the following investigations: postdepositional mobility of some transition elements, P, U, and Th in deep sea sediments; final desiccation of the Afar Rift, Ethiopia; U content of Caribbean cores; mineralogy of Afar Rift, Pa, Th, and U content in atmospheric dust; mineralogy and petrology of rocke samples from fractured zones of the equatorial Mid-Atlantic Ridge; and Th and U isotope contents in marine ferromanganese deposits. NSA

N72-21367# Alaska Univ., College. Geophysical Inst.
**EARTH TILTS IN CONNECTION WITH CRUSTAL FAILURE: A STUDY IN ALASKA Annual Progress Report**
Ed. Berg Oct. 1971 23 p refs
(Contract AT(45-1)-2229)
(RLO-2229-T-4-1) Avail: NTIS

Several tilt steps associated with local, regional and distant earthquakes have been recorded during the research period covered. The records confirm the conclusion drawn perviously that the steps observed are genuine and not due to instrumental malfunctioning. Propagation velocity and amplitude relationship appear more complicated than previously indicated. Propagation velocities are smaller for local shocks and increase for regional and distant earthquakes. The amplitudes of the observed tilts are much higher than those calculated from static dislocation models. Author

N72-21368# United Kingdom Atomic Energy Authority, Harwell (England). Analytical Sciences Div.
**USE OF NON DESTRUCTIVE GAMMA ACTIVATION FOR THE ANALYSIS OF ROCK AND BIOLOGICAL MATERIALS**
J. S. Hislop and D. R. Williams Sep. 1971 24 p refs
(AERE-R-6910) Avail: AEC Depository Libraries

High energy (35 to 40 MeV) gamma photon activation and high resolution gamma ray spectrometry were used for the intact analysis of the standard rock materials W-1, G-1, and BCR-1, and Apollo 12 returned samples 12022 and 12065, and the reference biological material kale. Simultaneous irradiation of appropriate synthetic standards containing thirty-nine elements

showed that the technique is particularly valuable for the determination of iron, calcium, titanium, strontium, zirconium, cesium, antimony, thallium, arsenic, rubidium, lead, mercury, and nickel. Provided chemical separations are carried out, sensitivities of 0.02 to 5 micrograms may be achieved. Author (NSA)

**N72-21369#** Environmental Research Corp., Las Vegas, Nev.
**PREDICTIONS OF GROUND MOTION, RIO BLANCO EVENT**
Nov. 1971 64 p refs
(Contract AT(29-2)-1163)
(NVO-1163-228) Avail. NTIS

Ground motion predictions were made for the Rio Blanco event. The ground motion predictions consist of: pseudorelative velocity spectra at selected locations and distances; peak vector acceleration, velocity, and displacement for selected locations and as a function of distance; and peak horizontal component acceleration, velocity, and displacement at selected locations. The procedures and data used to make the ground motion predictions are described. The equivalent seismic source for Rio Blanco was taken to be a single detonation with an elastic radius which bounds the predicted nonlinear region associated with the multiple detonation. The single source defined by this criterion has a yield of 123 kt and a depth of burial of 6373 feet. The uncertainties in the mean predictions were estimated by combining the distribution of the observed Rulison data with previously defined measures of source variability, using statistical techniques. Author (NSA)

**N72-21370#** Joint Publications Research Service, Washington, D.C.
**RADIOACTIVITY OF THE ATMOSPHERE**
K. P. Makhonko, ed. AEC Oct. 1971 160 p refs Transl. into ENGLISH of "radioaktivnost Atmosfery" from reports on a symp., Obninsk, 30 Jul. - 2 Aug. 1968 Moscow, Moskovskoe Otdelenie Gidrometeoizdta, 1970
(AEC-tr-7268; Conf-680733) Avail: NTIS

Survey lectures are presented concerning the research findings in the study of manmade and natural radioactivity in the atmosphere. The participants included the hydrometeorological services of the Hungarian Peoples Republic, Democratic Republic, USSR, and Czechoslovakian SSR. The lectures were presented at a symposium held during the Fifth Session of the Working Group of experts from the socialist countries on radioactivity of air and atmospheric fallout. The information is intended for use by specialists in the field of nuclear meteorology, workers in the hydrometeorological service, scientific workers, research students, and other students concerned with the field covered.
Author (NSA)

**N72-21371#** Environmental Research Corp., Las Vegas, Nev.
**PRELIMINARY CONSIDERATIONS OF GROUND MOTION FROM A VERTICALLY ORIENTED MULTIPLE DETONATION**
F. W. Power and S. L. Williams Nov. 1971 73 p refs
(Contract AT(29-2)-1163)
(NVO-1163-227) Avail: NTIS

Finite difference calculations were performed with the SHELP elastic wave propagation code to compare ground motions from vertically oriented multiple nuclear detonations in a half-space with ground motions from a corresponding single detonation of the same total yield. Computations were performed at depths of 0.75 km and 2.25 km. Two vertically oriented multiple detonations were studied for cases where the fracture regions overlapped and where they were separated. Detonation of one of the two charges a few milliseconds later than the other was also studied for the case of overlapping elastic radii.
Author (NSA)

**N72-21372#** Instituto Geografico y Catastral, Madrid (Spain). Seccion 1.
**ANNALS OF THE CENTRAL GEOPHYSICAL OBSERVATORY ALFONSO REY PASTOR, TOLEDO: GEOMAGNETISM. 1968 [ANUARIO DEL OBSERVATORIO CENTRAL GEOFISICO ALFONSO REY PASTOR, TOLEDO: ANO 1968, GEOMAGNETISMO]**
1970 264 p In SPANISH
Avail: NTIS

The geomagnetic data collected by the different geophysical observatories in Spain during the year 1968 are tabulated, and annual as well as seasonal variations are discussed. ESRO

**N72-21373#** Institut Franco-Allemand de Recherches, St. Louis (France).
**AEROSOL LAYERS IN THE ATMOSPHERE**
F. Roessler 29 Apr. 1971 18 p refs
(Contract T-0260/12630/11013)
(ISL-6/71) Avail: NTIS

Diffuse skylight (radiation) was measured by balloon and rocket sounding in order to determine the concentration of dust particles in the atmosphere. The sunlight scattered by air molecules as well as aerosol particles was determined as a function of height. ESRO

**N72-21374#** Woods Hole Oceanographic Institution, Mass.
**TRANSPORT FLOAT MEASUREMENTS AND HYDROGRAPHIC STATION DATA FROM THREE SECTIONS ACROSS THE GULF STREAM NEAR 67 DEGREES WEST: R. V. CRAWFORD CRUISE 168, JUNE - JULY 1968**
Joseph Barrett and William Schmitz Nov. 1971 97 p refs
(Contract N00014-66-C-0241; NR Proj. 083-004)
(AD-734419; WHOI-Ref-71-66) Avail: NTIS CSCL 08/3

Three transects of the Gulf Stream between Cape Cod and Bermuda including data from transport float (free fall instrument) observations and hydrographic stations are presented and compared. Measured volume transport (by transport float observations) appeared to decrease from 180 plus or minus 20 to 113 plus or minus 20 million cu m/sec in a period of less than one week. Geostrophic calculations based on a reference level at the ocean bottom gave a volume transport of 100 to 120 million cu m/sec. Although the stream appeared to extend to the ocean bottom on all three sections, deep countercurrents (westward flow) were also observed on two of the sections.
Author (GRA)

**N72-21375#** Woods Hole Oceanographic Institution, Mass.
**HUDSON '70 GRAVITY OBSERVATIONS 62.9 DEGREES - 57.5 DEGREES N ALONG 150 DEGREES W**
W. S. Vonarx, D. C. Bowen, J. P. Dean, and R. T. Haworth Nov. 1971 67 p
(Contract N00014-66-C-0241; NR Proj. 033-004)
(AD-735114; WHOI-Ref-71-68) Avail: NTIS CSCL 08/5

To provide geoidal topography over the world oceans, a radar altimeter carried by earth satellite is planned. Ground truth calibration will be provided by a grid comprised of the equatorial belt and meridional traverses along the 30 degrees W and 150 degrees W meridians. Ground truth topography is derived from gravity values measured along these traverses. This report presents the free air gravity values and the computed free air anomalies obtained from 62.9 degrees S to 57.5 degrees N along the 150 degrees W meridian. Author (GRA)

**N72-21376#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**ABOUT THE ANOMALY OF ELECTROCONDUCTIVITY AT THE BOUNDARY OF THE EARTH'S CRUST-MANTLE IN THE IRKUTSK AMPHITHEATRE**
M. A. Portnyagin 26 Oct. 1971 17 p refs Transl. into ENGLISH from Geol. Geofiz. (Novosibirsk), no. 12, 1968 p 93-100
(AD-734905; FTD-MT-24-1414-71) Avail: NTIS CSCL 08/7

By the analysis of magnetotelluric sounding (MTS) in Irkutsk amphitheater new data on the layer of high electric conductivity at a depth of about 40 km are obtained. The general distribution of this layer within the amphitheater and incidence of its depth with the earth's crust thickness on the seismology and gravimetry

data suggest this anomaly of high electric conductivity to be coincident with the discontinuity earth's crust-mantle.
Author (GRA)

**N72-21377#** California Univ., Berkeley. Space Sciences Lab.
**RELATIONSHIP BETWEEN ELECTROSTATIC TURBULENCE AND SPREAD F**
Michael C. Kelly 10 Dec. 1971 11 p refs Submitted for publication
(Contract N00014-69-A-0200-1015)
(AD-735099; SSL-Ser-12-Issue-99) Avail: NTIS CSCL 05/1

A three-axis double probe electric field detector has been flown on the OV1-17 satellite in a circular polar orbit near the noon-midnight meridional plane at an altitude of about 400 km. The detector was sensitive to electric fields in the frequency range from dc to about 500 hertz. Thirty-seven orbits of vector electric field measurements were obtained for analysis during the month of April, 1969. The purpose of this letter is to present evidence that turbulent low frequency electric field fluctuations are intimately associated with the disturbed F region ionosphere, spread F, and scintillations of radio stars and satellites. GRA

**N72-21378#** Naval Undersea Research and Development Center, San Diego, Calif.
**THERMAL STRUCTURE DYNAMICS IN THE UPPER 500 METERS OF THE INDIAN OCEAN**
J. G. Colburn Nov. 1971 103 p refs
(SR Proj. 104-03-01; SF Proj. 11-552-101)
(AD-734668; NUC-TP-266) Avail: NTIS CSCL 08/10

The International Indian Ocean Expedition (1960-65) has for the first time provided a sufficiently complete data set to support an investigation of the oceanographic and climatic seasonal influence on Indian Ocean thermal structure in the upper 500 m and north of 40 degrees S lat. Analysis of 23,847 bathythermograph and Nansen Cast measurements form the basis for a division of the Indian Ocean into 32 separate Primary Areas with distinct thermal features. The basic thermal parameters considered in the analysis and depicted graphically in this report include mixed-layer depth, maximum thermal gradient, five parameters of the permanent thermocline, and 2C-interval isotherm depths to 500 m. The thermal structure within each oceanographic region is qualitatively evaluated in terms of the relative effects of net surface heat exchange, heat advection, and circulation dynamics. Author (GRA)

**N72-21379#** Naval Postgraduate School, Monterey, Calif.
**PROPERTIES OF THE DISCRETELY STRATIFIED MICROSTRUCTURE IN THE ARCTIC OCEAN M.S. Thesis**
William Clifford Barney Sep. 1971 90 p refs
(AD-734973) Avail: NTIS CSCL 08/10

The layered microstructure in the Arctic Ocean is examined from long time-series of high-resolution temperature profiles and concurrent digital salinity data. The motion within the layers is found to be turbulent, while the flow within the interface sheets is laminar. The structure is stable for long periods of time, and is coherent for a considerable horizontal extent. It is suggested that the initial formation of the layers is due to the energy dissipation of higher modes of locally generated internal waves. The layers may be sustained for long periods by weak shear produced by geostrophic density currents. The distribution of salinity and temperature differences between layers indicates that the layers are in a state of dynamic equilibrium, the differing diffusion characteristics of heat and salt accounting for the transfer of these properties across the interface sheets.
Author (GRA)

**N72-21380#** Naval Postgraduate School, Monterey, Calif.
**A BATHYMETRIC CHART OF CARMEL BAY, CALIFORNIA M.S. Thesis**
Ralph Anthony Zardeskas Sep. 1971 114 p refs
(AD-734986) Avail: NTIS CSCL 08/10

The study has as its final product a bathymetric chart of Carmel Bay, California, which is improved over any other previously existing chart. The unique problems of applying the echo-sounding corrections necessary to create accurate bathymetric charts of areas with steep bottom slopes are discussed. Author (GRA)

**N72-21381#** Florida State Univ., Tallahassee.
**APPLICATION OF PHASE SOUNDER GRAVITY WAVE OBSERVATIONS TO THE PROBLEM OF ATMOSPHERIC STRUCTURE Final Report, 1 Dec. 1970 - 30 Nov. 1971**
Ivan Tolstoy 30 Nov. 1971 40 p refs
(Contract F44620-69-C-0043; ARPA Order 1320; ARPA Proj. 1F10-02)
(AD-735386; AFOSR-72-0083TR) Avail: NTIS CSCL 04/1

The practical consequences of the commonly occurring thermospheric condition of turning points for propagating acoustic and internal gravity wave modes have been investigated. This has required some rather novel theoretical developments on the W.K.B. approximation, turning points, and the measurement of phase velocities. In the process of carrying out this investigation some sample calculations were made illustrating the relationships between phase velocity measurements and the existing values of the Vaisala frequency and acoustic cut-offs. A study was also made of the reflection of internal gravity waves of long period at heights for which the wavelength becomes of the order of the mean free path of the molecules. The net effect is one of damping on the long-range propagation of trapped internal waves. Author (GRA)

**N72-21382#** California Univ., Los Angeles. Plasma Physics Group.
**PITCH-ANGLE DIFFUSION OF RADIATION BELT ELECTRONS WITHIN THE PLASMASPHERE**
Lawrence R. Lyons, Charles F. Kennel, and Richard Mansergh Thorne Jan. 1972 65 p refs
(Contract N00014-69-A-0200-4023; Grant NSF GP-22817)
(AD-735934; PPG-104) Avail: NTIS CSCL 04/1

The goal of this work is to explain the formation of the quiet-time electron slot, which divides the radiation belt electrons into an inner and an outer zone. The authors quantitatively investigate the pitch-angle diffusion of radiation belt electrons resulting from resonant interactions with the observed plasmaspheric whistler-mode wave band. The effects of wave propagation obliquely to the geomagnetic field direction with the resulting diffusion at all cyclotron harmonic resonances and the Landau resonances are evaluated along with the effects of interactions occurring at all geomagnetic latitudes. The results account for the long term stability of the inner radiation zone, the location of its outer edge as a function of electron energy, and the removal of electrons to levels near zero throughout the slot. Computed pitch-angle distributions and precipitation decay rates are in good agreement with slot-region observations.
Author (GRA)

**N72-21383#** Washington Univ., Seattle. Div. of Marine Resources.
**ARCTIC TECHNOLOGY DEVELOPMENT AT THE UNIVERSITY OF WASHINGTON Semiannual Report, 1 Jul. - 31 Dec. 1971**
Stanley R. Murphy 31 Dec. 1971 98 p See also rept. dated 20 Aug. 1971, AD-728815
(Contract N00014-67-A-0103-0016; ARPA Order 1668)
(AD-735957) Avail: NTIS CSCL 08/12

A synopsis of the sponsored arctic technology development at the University of Washington is presented. This includes a description of the developmental progress made on the Unamnned Arctic Research Submersible (UARS), and a presentation of three recommended arctic technology projects. These projects (the development of an ice pack research support vehicle, the development of a remote acoustic telemetry link for under-ice sensor systems, and experiments in ice albedo modification) are described in detail and rationale to support their early accomplishment is given. Author (GRA)

N72-21384# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
**SUMMARY OF INSTITUTE PROCEEDINGS AURORA AND AIRGLOW, 1970 Final Report**
Billy M. McCormac, J. N. Bradbury, and John E. Evans Feb. 1971 48 p refs
(Contract N00014-70-C-0320)
(AD-735151; LMSC-4-05-71-C) Avail: NTIS CSCL 04/1

The presentations and discussions of the Summer Advanced Study Institute, 'Aurora and Airglow, 1970' are summarized. Author (GRA)

N72-21385# Army Foreign Science and Technology Center, Charlottesville, Va.
**PRODUCTION TESTING OF THE DNK-02 LIGHT DISTANCE MEASURING DEVICE**
L. I. Pikand and E. Nikanorov 27 Oct. 1971 8 p Transl. into ENGLISH from Gedez. i Kartograf. (Moscow), no. 6, 1970 p 17-20
(AD-735235; FSTC-HT-23-1281-71) Avail: NTIS CSCL 08/5

The DNK-02 light distance measuring device was field-tested in traversing and in measuring theodolite legs. Author (GRA)

N72-21386# Pennsylvania State Univ., University Park. Ionospheric Research Lab.
**MODELING THE D-REGION PARTIAL REFLECTION EXPERIMENT**
David Jack Cohen 1 Nov. 1971 113 p refs
(Contract N00014-67-A-0385-0014; Grant NSF GA-13985)
(AD-735514; PSU-IRL-SCI-378) Avail: NTIS CSCL 04/1

A new volume model is developed to explain the echoes which are returned in the partial reflection experiment from weak D-region irregularities. This volume model is the first model that accounts for the two opposing effects of increasing electron density and added differential absorption which oppose one another within the pulse width. A previous volume model by Flood only included the effect of added differential absorption within the pulse. Computer solutions are presented for the volume model. Author (GRA)

N72-21387# Lincoln Lab., Mass. Inst. of Tech., Lexington.
**MILLSTONE HILL THOMSON SCATTER RESULTS FOR 1967**
John V. Evans 22 Jul. 1971 65 p refs
(Contract F19628-70-C-0230; DA Proj. 7X2-63304-D-215)
(AD-735727; TR-482; ESD-TR-71-199) Avail: NTIS CSCL 04/1

The report summarizes results for the electron density distribution and electron temperature of the F-region obtained during 1967 using the Millstone Hill Thomson (incoherent) scatter radar system. These data, for the height interval of approximately 200 to 800 km, were gathered over 24-hour observing periods twice per calendar month. The time required to obtain a complete electron density and temperature profile over this height interval was 30 minutes. GRA

N72-21388# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
**EARTH'S PARTICLES AND FIELDS, 1971 Final Report**
Billy M. McCormac, John E. Evans, A. C. Durney (ESRO, Domeinweg-Noordwikj, Holland), and C. R. Chappell Dec. 1971 72 p refs
(Contract N00014-71-C-0395; NR Proj. 089-075)
(AD-735149) Avail: NTIS CSCL 04/1

Contents: Highlights of particles and fields in the magnetosphere; Magnetospheric structure and processes; Magnetospheric particles; Acceleration and diffusion; Electric fields and plasma convection; Magnetospheric substorms. GRA

N72-21389# Naval Oceanographic Office, Washington, D.C. Applications Research Div.
**BIRDS EYE 3-71, 2-25 MARCH 1971 Arctic Ice Data, 2-25 Mar. 1971**
R. F. Freeman Nov. 1971 229 p
(AD-735871; NOO-IR-71-10) Avail: NTIS CSCL 08/12

BIRDS EYE 3-71 was a regularly scheduled ice reconnaissance mission covering the North American sector of the Arctic Ocean and included Denmark Strait and Greenland Sea between 2 and 25 March 1971. An airborne laser profilometer system was used to obtain ice surface profiles. An infrared scanner and aerial camera were used to assess ice conditions. Ice observations were made under daylight or twilight conditions. Data were collected at Camp 200 (Project AIDJEX) on 21 and 23 March. Coincidental USCGC EDISTO (WAGB-284) ice data collected in Denmark Strait are appended. Author (GRA)

N72-21390# SACLANT ASW Research Center, La Spezia (Italy).
**THE CALCULATION OF THE SURFACE BACKSCATTERING COEFFICIENT OF UNDERWATER SOUND FROM MEASURED DATA**
Wolfgang Bachmann and Bernard deRaigniac 1 Nov. 1971 40 p refs
(AD-735995; SACLANTCEN-TR-174) Avail: NTIS CSCL 20/1

The prediction of sonar performance requires valid models for propagation and reverberation of sound. The report describes an improved technique for determining surface backscattering coefficients from field data. High precision, compared with conventional methods of backscattering analysis, has been achieved by taking into account the temperature-profile and volume-scattering profile. Author (GRA)

N72-21391# Scripps Institution of Oceanography, San Diego, Calif. Marine Physical Lab.
**SURVEY OF HYDROPHONE ACCELERATION RESPONSES**
Earl D. Squier 1 Aug. 1971 145 p
(Contract N00014-69-A-0200-6002; NR Proj. 260-103)
(AD-735931; SIO-Ref-71-19; MPL-U-47/1) Avail: NTIS CSCL 20/1

A set of fourteen hydrophone types, some submitted for test by manufacturers and others the property of the Marine Physical Laboratory, were tested for acceleration response. The acceleration was introduced as vertical acceleration along the suspending cable. Acoustic calibrations were carried out at the Naval Undersea Research and Development Center TRANSDEC facility. The data from these tests are presented in the report. Author (GRA)

N72-21392# Stanford Research Inst., Menlo Park, Calif.
**TRIGGERED LIGHTNING AND SOME UNSUSPECTED LIGHTNING HAZARDS**
Edward T. Pierce Jan. 1972 25 p refs Presented at Ann. Meeting of the Am. Assoc. for the Advan. of Sci., 138th, Philadelphia, 27 Dec. 1971
(Contract N00014-71-C-0106; SRI Proj. 4454)
(AD-735917; SN-15) Avail: NTIS CSCL 04/1

The paper considers instances of lightning initiated by man's activities. These include the triggering of lightning by high-rise buildings and other tall structures; by rockets trailing wires; by the column of water thrown up by a depth-charge; by the large Apollo 12 rocket; by aircraft; and by thermonuclear explosions. All the incidents occur when the ambient electric field is some 10,000 volts per meter, and the voltage discontinuity between the conductor initiating the lightning and the adjacent atmosphere is about a million volts. It is pointed out how solid-state devices and microcircuitry, computers, plastics, and electrically composite materials, are all quite vulnerable to the effects of lightning. These components are being increasingly used in aircraft construction and operation. Also, as aircraft become bigger and faster they have a greater propensity to trigger lightning. Therefore it is concluded that the lightning hazard to aircraft operation is increasing. Author (GRA)

N72-21393# Naval Postgraduate School, Monterey, Calif.
**AN EXPERIMENTAL METHOD OF DETERMINING BALLISTIC WINDS MAKING DIRECT USE OF SIRS RADIANCES Final Report, Jul. - Dec. 1971**
Russell C. Elsberry, John W. Wright, and Frank L. Martin 31 Dec. 1971 48 p refs
(AD-735898; NPS-51ES/MR71121A) Avail: NTIS CSCL 04/1

A proposed ballistic wind determination technique using the satellite infrared spectrophotometer (SIRS) data from NIMBUS 3 and 4 was tested. The general approach was to derive regression equations from a dependent data sample of nearly coincident subsatellite points and rawinsonde locations. The validity of the equations was checked with a smaller independent sample of SIRS radiances from a later period. Tests with the ballistic wind component normal to the path of the NIMBUS 3 suggested standard errors of less than 10 kts can be achieved. Both zonal and meridional components can be calculated from SIRS-B radiance data which is grouped in clusters. Because the geostrophic ballistic wind is proportional to a horizontal gradient, several techniques were attempted for calculating the gradient at the central point of the irregularly spaced set of data.
Author (GRA)

N72-21394# Air Force Cambridge Research Labs., L. G. Hanson Field, Mass.
**AFCRL'S EXPERIMENTAL AERIAL GRAVIMETRY PROGRAM Environmental Research Papers, Dec. 1965 - Mar. 1968**
David Anthony and Robert M. Perry 27 Jul. 1971 40 p refs
(AF Proj. 7600)
(AD-735266; AFCRL-71-0411; AFCRL-ERP-366) Avail: NTIS CSCL 08/5

Between December 1965 and March 1968 AFCRL conducted a series of experimental aerial gravity measurements to determine the feasibility of large scale aerial gravity surveys. This report gives the results of the program and includes a program background, instrumentation description including the four gravimeters tested, upward continuation of gravity methods and evaluation in the test area, data processing procedures including corrections and smoothing methods applied, representative sample profiles, accuracy achieved in terms of profile and mean anomalies, and other aerial gravity tests and studies including helicopter gravity tests, a systems analysis of aerial gravimetry, and gravimetry by means of gradient measurements.
Author (GRA)

N72-21395# Naval Civil Engineering Lab., Port Hueneme, Calif.
**NUCLEAR METERING OF SOIL DENSITY AND MOISTURE CONTENT AT DEPTH: ANALYSIS OF MEASUREMENTS, DETERMINATION OF ERRORS, AND EVALUATION OF ABILITY TO DETECT TEMPORAL VARIATIONS IN SOIL PROPERTIES Final Report, Sep. 1968 - Sep. 1969**
D. G. True Oct. 1971 90 p refs
(YF38534002)
(AD-735448; NCEL-TR-742) Avail: NTIS CSCL 08/13

A study was conducted of the potential applicability of nuclear measuring techniques for determining soil density and moisture content at depth, and changes in these properities, for Navy civil engineering purposes. Measurements were obtained under two different types of engineering requirement to assess measurement capabilities: (1) in base material and subgrade soil beneath the pavements at five airfields, to detect long term variations; (2) in hydraulically placed foundation soils at two construction sites, both before and after densification of the soil was attempted by driving compaction piles, to detect changes due to the densification effort. The data were analyzed and statistical procedures were developed to determine the magnitudes of measurement error. Measurement errors were relatively low compared with the measured temporal variations in the soil properties at the soil densification sites, but were so large as to obscure a large portion of low-level, long-term changes occurring in the pavement subgrades.
Author (GRA)

N72-21396# Geological Survey, Menlo Park, Calif.
**NATURAL PERIOD OF TWO-LAYER SYSTEMS Final Report**
Albert T. F. Chen Sep. 1971 34 p refs
(PB-205260; USGS-GD-71-030) Avail: NTIS CSCL 20K

Linearly elastic, horizontally layered systems subjected to horizontal base motions are considered. A general method for determining natural periods of two-layer systems is presented and the effects of the impedance ratio on the distribution of natural periods of two-layer systems are analyzed. A procedure for extending the results derived for two-layer systems to N-layer systems is proposed, and some guidelines for treating embedded thin layers are suggested.
Author (GRA)

N72-21397# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
**A NOTE ON THE HIGH-LATITUDE DENSITY BULGE INFERRED FROM LOW-ALTITUDE SATELLITE DRAG DATA Final Report, Jun. - Oct. 1971**
Barbara K. Ching 31 Dec. 1971 17 p refs
(Contract F04701-71-C-0172)
(AD-735664; TR-0172(2260-10)-8; SAMSO-TR-71-329) Avail: NTIS CSCL 04/1

Drag data from the satellite OV1-15 are compared with the newest density model by Jacchia (1971a) at altitudes below 200 km. Residuals between the observed and model density indicate the presence of a high-latitude density bulge, thereby confirming the results of a previous study which was based on an older Jacchia model (1970). Recent composition measurements in the polar regions have indicated that the N2 density is enhanced in a localized region, but not O. This anomaly persists even under geomagnetically quiet conditions. These results provide an explanation of why a polar-region density bulge has been observed consistently only at low altitudes (-200 km) where N2 is the major constituent, but not at higher altitudes where O predominates.
Author (GRA)

N72-21398# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
**DESIGN OF UNSURFACED SOIL FACILITIES FOR OPERATIONS OF C-5A AIRCRAFT Final Report**
Donald M. Ladd and Victor C. Barber Dec. 1971 56 p refs
(AD-735344; AEWES-Misc-Paper-S-71-27) Avail: NTIS CSCL 08/13

The purpose of the study reported was to obtain data to validate or modify, if necessary, existing criteria for the operation of the C-5A aircraft on unsurfaced airfields. Two specially prepared test sections were constructed and trafficked. Test section 1 consisted of a three-item test lane designed for evaluation of surface strength requirements and was trafficked with a 12-wheel C-5A gear arrangement loaded to 25,200 lb. Test section 2 consisted of two traffic lanes (lanes 1 and 2) of four items each designed for evaluation of thickness requirements. Lane 1 was trafficked with a 35,000-lb single-wheel load, and lane 2 was trafficked with the 12-wheel C-5A gear arrangement. An analysis of the test data showed that existing criteria could be used to design unsurfaced airfields for operations of C-5A aircraft.
Author (GRA)

N72-21399# Lamont-Doherty Geological Observatory, Palisades, N.Y.
**LONG-PERIOD SEISMOLOGICAL RESEARCH PROGRAM Semiannual Report**
Lynn R. Sykes and John M. Savino 25 Oct. 1971 18 p refs
(Contract F44620-71-C-0082; AF Proj. A01774)
(AD-735765; AFOSR-720158-TR) Avail: NTIS CSCL 17/10

The most significant finding of the data analysis pertinent to the earthquake-explosion discrimination problem is one based on results from the seismic detection and earth noise studies. Visual examination of high-gain seismograms from CTA, FBK, and the station at Ogdensburg, NJ (OGD), for approximately 1,000 events in the magnitude range from m sub b 3.3 to about 6.5 indicates that surface waves with periods as long as 30 to 40

seconds are observable after most events, in particular the smallest magnitude events studied (e.g. m sub b = 3.6 recorded at FBK at epicentral distances of 5 to 10 degrees).
Author (GRA)

**N72-21400#** Aerospace Corp., El Segundo, Calif.
**SOLAR PHOTOABSORPTION AND THERMAL PROCESSES IN THE POLAR THERMOSPHERE** Technical Report, Jul. 1970 - Jun. 1971
Barbara K. Ching and Edward L. Breig 26 Nov. 1971 72 p refs
(Contract F04701-71-C-0172)
(AD-735305; TR-0172(2260-10)-5; SAMSO-TR-71-320) Avail: NTIS CSCL 04/1

The report reviews a number of physical processes that occur in the thermosphere and significantly affect its neutral state through the deposition or loss of thermal energy and by modification of its composition. Specifically, the processes discussed are: (1) thermal heating from absorbed solar radiation in the wavelength region below 2400 A, (2) photodissociation of O2, (3) thermal heating from atomic oxygen recombination, and (4) cooling by infrared emission of atomic oxygen. Basic concepts associated with the calculation of the various processes are discussed in detail, and most recent data on relevant physical parameters are reviewed. Numerical models of the heating, dissociation, and cooling are presented on the basis of a nominal atmospheric model. Special emphasis is placed on diurnal, seasonal, and latitudinal variations. Author (GRA)

**N72-21401#** Williams Coll., Williamstown, Mass.
**COMPUTER SIMULATION MODEL OF COASTAL PROCESSES IN EASTERN LAKE MICHIGAN**
William T. Fox and Richard A. Davis, Jr. 15 Dec. 1971 123 p refs
(Contract N00014-69-C-0151; NR Proj. 388-092)
(AD-736224; WC-5; TR-5) Avail: NTIS CSCL 13/2

A computer simulation model is used to study the relationships among barometric pressure, wind, waves, longshore currents, beach erosion and bar migration on the eastern shore of Lake Michigan. Harmonic trend analysis with a single Fourier series is used to represent the major trends in weather and wave parameters. In the simulation model, barometric pressure is plotted as a function of time and longshore current velocity is computed as the first derivative of barometric pressure. Breaker height closely approximated a modified form of the second derivative of barometric pressure. Daily profiles provide data for nearshore topographic maps. Author (GRA)

**N72-21402#** Army Foreign Science and Technology Center, Charlottesville, Va.
**AUTOMATION OF THE MAP COMPILATION PROCESS**
A. I. Martynenko Oct. 1971 26 p Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 9, 1970 p 50-64
(AD-736481; FSTC-HT-23-737-71) Avail: NTIS CSCL 08/2

The purpose of the report is to demonstrate the possibility of automating the process of compiling thematic and general geographic maps, using the example of one special map. The process is of importance in the need to develop modifications of astronavigational maps for various routes and for each flight day, as the values of the hour angle and the declination of a celestial body are changing constantly. Author (GRA)

**N72-21403#** Aerospace Corp., El Segundo, Calif. Space Physics Lab.
**UNIFIED THEORY OF SAR ARC FORMATION AT THE PLASMA PAUSE** Report for Jul. 1970 - Jul. 1971
John M. Cornwall, Ferdinand V. Coroniti (Calif. Univ., Los Angeles), and Richard M. Thorne (Calif. Univ., Los Angeles) 15 Dec. 1971 51 p refs
(Contract F04701-71-C-0172)
(AD-736431; TR-0172(2260-20)-12; SAMSO-TR-71-321) Avail: NTIS CSCL 04/1

The authors propose that stable auroral red arcs (SAR arcs) are generated at the plasmapause as a consequence of the turbulent dissipation of ring current energy. GRA

**N72-21123#** Air Force Cambridge Research Labs., L. G. Hanson Field, Mass.
**ON MODELLING THE ARCTIC IONOSPHERE**
G. J. Gassman *In* AGARD Radar Propagation in the Arctic Jan. 1972 8 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

**N72-21125#** Air Force Cambridge Research Labs., L. G. Hanson Field, Mass.
**A DISCUSSION OF ARCTIC IONOGRAMS**
R. A. Wagner and C. P. Pike *In* AGARD Radar Propagation in the Arctic Jan. 1972 20 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

**N72-21127#** National Research Council of Canada, Ottawa (Ontario). Astrophysics Branch.
**OBSERVATIONS OF 48 MHz AURORAL RADAR PROPAGATION ON A NETWORK IN THE AURORAL ZONE**
A. G. McNamara *In* AGARD Radar Propagations in the Arctic Jan. 1972 8 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

**N72-21128#** Max-Planck-Institut fuer Aeronomie, Lindau Uber Northeim (West Germany).
**CURRENT EXPERIMENTAL RESULTS FROM A VHF-CW AURORAL BACKSCATTER NETWORK IN SCANDINAVIA**
G. Lange-Hesse *In* AGARD Radar Propagation in the Arctic Jan. 1972 16 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

**N72-21132#** Western Ontario Univ., London. Centre for Radio Science.
**ION-ACOUSTIC WAVES IN AURORA**
P. A. Forsyth and G. F. Lyon *In* AGARD Radar Propagation in the Arctic Jan. 1972 5 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

## 14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

**N72-21404** National Lending Library for Science and Technology, Boston Spa (England).
**COULOMETRIC DETECTOR FOR GAS CHROMATOGRAPHY COMMUNICATION 3: DETERMINATION OF THE MICRO-IMPURITIES OF NITROGEN OXIDES, SULPHUR DIOXIDE AND AMMONIA IN GASES**
S. I. Krighmar, V. E. Stepangnko, and T. M. Galan [1971] 10 p refs Transl. into ENGLISH Zh. Anal. Khim. (USSR), v. 26, no. 7, 1971 p 1340-1343
(NLL-M-22138-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The possibility was examined of determining the micro-impurities of oxidants and reductants in gases in the case of their simultaneous occurrence. Methods were developed for the determination of the micro-impurities of nitrogen oxides, sulphur dioxide, and ammonia in gases. The method was based on the

combination of chemical and thermal methods of the conversion and absorption of gaseous impurities with the coulometric detector for gas chromatography. The volume of the analytical sample varied between 0.2 and 10 cc. The sensitivity of determination was 0.000001 to 0.0001 %, and an accuracy of 10-15 relative %. Author

**N72-21405*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**PRESSURE TRANSDUCER Patent**
Charles D. Baker, inventor (to NASA) Issued 30 Nov. 1971 8 p Filed 24 Mar. 1970 Supersedes N70-35439 (08 - 19, p 3540) Sponsored by NASA
(NASA-Case-NPO-10832; US-Patent-3,623,360;
US-Patent-Appl-SN-22265; US-Patent-Class-73-141A) Avail: US Patent Office CSCL 14B

A pressure transducer for use in systems employed in measuring forces of compression is characterized by a number of spaced electrical conductive elements with electrical insulators of a controlled resiliency. These are adapted to be sequentially collapsed through stress induced in the presence of an applied compressive force of a continuously increasing magnitude to accommodate a successive engagement of the adjacent surfaces of the conductors. Thus a series of electrical circuits is completed as the magnitude of the applied force is increased. A feature of the transducer is the employment of a current detector circuit connected with each of the conductors so that as an increasing compressive force is applied, and successive conductors are brought into a contiguous relationship, additional circuits are completed, establishing a series of electrical signals indicative of the magnitude of the applied force.
Official Gazette of the U.S. Patent Office

**N72-21406*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**PENETROMETER Patent**
Isak Kloc, inventor (to NASA) Issued 30 Nov. 1971 6 p Filed 19 Jan. 1970 Supersedes N70-34674 (08 - 18, p 3354) Sponsored by NASA
(NASA-Case-NPO-11103; US-Patent-3,623,359;
US-Patent-Appl-SN-3654; US-Patent-Class-73-84) Avail: US Patent Office CSCL 14B

A penetrometer is described that is particularly suited for use in empirically determining the load-bearing characteristics of inclined surfaces of remotely located bodies of soil. The device is characterized by a penetrometer mount rotatably supporting a vertically driven probe. A provision is made for supporting the probe for simultaneous displacement in both vertical and lateral directions. The extent of the resulting lateral displacement imposed on the probe can be detected and measured for purposes of accurately indicating the true load-bearing characteristics of the surface, regardless of its angle of inclination. Official Gazette of the U.S. Patent Office

**N72-21407*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**OPTICAL PROBING OF SUPERSONIC FLOWS WITH STATISTICAL CORRELATION Patent**
Buford H. Funk, Jr., inventor (to NASA) Issued 30 Nov. 1971 15 p Filed 4 Nov. 1969 Supersedes N70-20741 (08 - 08, p 1445)
(NASA-Case-MFS-20642; US-Patent-3,623,361;
US-Patent-Appl-SN-873793; US-Patent-Class-73-147) Avail: US Patent Office CSCL 14B

This equipment provides a reliable remote sensing tool for measuring the statistical properties of supersonic turbulence which neither affects the flow field nor is adversely affected by it. Two laser beams are directed through the supersonic boundary layer in the test section of a wind tunnel. If the layer is two-dimensional, the laser beams may be placed parallel to each other. Otherwise, the laser beams are positioned so as to restrict the volume of flow being examined to that common in both beams. It has been discovered that the turbulence crossing both beams may more easily be statistically correlated by the use of a rotatable knife-edge before the photodetector and both the most probable translational and rotational motion of the turbulent structure determined. The signals from the photodetector are correlated by a computer and the correlated data signal is inputed into an oscilloscope or other recording means for viewing. Official Gazette of the U.S. Patent Office

**N72-21408*** Barnes Engineering Co., Stamford, Conn.
**MINIATURE CARBON DIOXIDE SENSOR AND METHODS Patent**
Thomas F. McHenry, inventor (to NASA) Issued 19 Oct. 1971 6 p Filed 1 Oct. 1970 Sponsored by NASA
(NASA-Case-MSC-13332-1; US-Patent-3,614,431;
US-Patent-Appl-SN-77169; US-Patent-Class-250.43.5R;
US-Patent-Class-250-83.3H) Avail: US Patent Office CSCL 14B

A fast response, miniature CO2 detector with no moving parts is disclosed for determining the CO2 concentration of any given atmosphere. The embodiment includes a sensor housing having separate chambers, one of which receives a sample atmosphere and the other which contains a reference atmosphere. The chamber having the reference atmosphere is hermetically sealed and contains separate infrared light source and detector pairs. The sources are alternately actuated by a multivibrator. An optical arrangement includes a 4.27-micron filter for one source and directs energy through first and second optical paths to each detector, where the first path traverses the sample chamber and the second path traverses the reference chamber. If CO2 is present in the sample chamber, the 4.27-micron energy is absorbed to affect the signal output of a corresponding CO2 detector while the 4.27-micron energy to the other reference detector is not affected.
Official Gazette of the U.S. Patent Office

**N72-21409*** National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**OPTICAL RANGE FINDER HAVING NONOVERLAPPING COMPLETE IMAGES Patent**
William E. Lyon, inventor (to NASA) Issued 19 Oct. 1971 7 p Filed 30 Sep. 1968
(NASA-Case-MSC-12105-1; US-Patent-3,614,228;
US-Patent-Appl-SN-763743; US-Patent-Class-356-17;
US-Patent-Class-356-18) Avail: US Patent Office CSCL 14B

A 90-100 percent reflective first surface mirror is disposed to direct a reflected image to a 70 percent reflective, 30 percent transmitting beam splitter which reflects the reflected image along a light path parallel to the light path of the true image to produce two separate full view images. The true image and reflected image are directed through a magnifying telescope having infinite projected crossed vertical and horizontal reticles. The mirror is rotatable to change the vertical displacement of the reflected image from the horizontal reticle and when the two images are equally displaced from the horizontal reticle, the range of the image may be found by triangulation.
Official Gazette of the U.S. Patent Office

**N72-21410*#** General Instrument Corp., Hicksville, N.Y. Electronic Systems Div.
**NIMBUS 4/IRLS BALLOON INTERROGATION PACKAGE (BIP) Final Report**
Oct. 1971 89 p
(Contract NAS5-21110)
(NASA-CR-122375) Avail: NTIS CSCL 14B

The balloon interrogation package (BIP), an integral part of the overall interrogation, recording, and location subsystems (IRLS) for the Nimbus 4 program, is described. The BIP is a self-contained, integrated transponder designed to be carried aloft by a constant altitude, superpressure balloon to an altitude of 67,000 or 78,000 feet. After launch the BIP senses high-altitude balloon overpressure and temperature, and upon receipt of an interrogated command from the IRLS aboard the Nimbus 4 satellite, the BIP enodes the data on a real-time basis into a pulse-code modulation (PCM) format and transmits this data to the satellite. A summary of the program activity to

produce 30 BIP systems and to support balloon launches from Ascension Island is presented. Author

**N72-21411*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**FOURIER SPECTROSCOPY WITH A ONE-MILLION-POINT TRANSFORMATION**
Janine Connes, Herve Delouis, Pierre Connes, Guy Guelachvili, Jean-Pierre Maillard, and Guy Michel 15 Mar. 1972 60 p refs Transl. into ENGLISH from Nouv. Rev. Opt. Appl. (Paris), v. 1, 1970 p 3-22
(Contract NAS7-100)
(NASA-CR-125980; JPL-TM-33-525) Avail: NTIS CSCL 14B

A new type of interferometer for use in Fourier spectroscopy has been devised at the Aime Cotton Laboratory of the National Center for Scientific Research (CNRS), Orsay, France. With this interferometer and newly developed computational techniques, interferograms comprising as many as one million samples can now be transformed. The techniques are described, and examples of spectra of thorium and holmium, derived from one million-point interferograms, are presented. Author

**N72-21412*#** Battelle Memorial Inst., Columbus, Ohio.
**DYNAMIC RESPONSE OF HIGH-FREQUENCY PRESSURE TRANSDUCERS TO LARGE AMPLITUDE SINUSOIDAL PRESSURE OSCILLATIONS**
Richard E. Robinson Washington NASA Apr. 1972 35 p refs
(Contract NAS3-11229)
(NASA-CR-2000) Avail: NTIS CSCL 14B

Dynamic response characteristics of six currently used dynamic pressure transducers were investigated by using a large-amplitude sinusoidal-pressure generator. Frequencies between 1 and 15 kilohertz with corresponding peak-to-peak pressure-oscillation amplitudes ranging between 73 and 8 percent of bias pressure and bias pressures between 15 and 300 psia were utilized. Amplitude-ratio data as functions of frequency and pressure level are given for all transducers. The generator design and performance and associated instrumentation are described.
Author

**N72-21413*#** Techtran Corp., Glen Burnie, Md.
**RESULTS OF THE DEVELOPMENT AND TESTING OF THE AM-15 BIMETALLIC THERMOMETER PROBE**
L. A. Shestopalov Washington NASA Apr. 1972 28 p refs Transl. into ENGLISH from Tr. Nauchn.-Issled. Inst. Gidrometeorol. Priborostr. (Leningrad), no. 12, 1964 p 123-139
(Contract NASw-2037)
(NASA-TT-F-14226) Avail: NTIS CSCL 14B

A bimetallic probe thermometer, its design and performance features, calculation procedure and basic results of field and laboratory tests are described. The device measures the temperature of the tillable soil layer to a depth of 25 cm to an accuracy of 1-1.5 C. The short lag time of the thermometer probe makes it more convenient and reliable than other temperature probes. Author

**N72-21414*#** Techtran Corp., Glen Burnie, Md.
**DYNAMIC THERMOCAPACITIVE SOIL-MOISTURE SENSOR**
B. S. Zalivadnyy Washington NASA Apr. 1972 3 p ref Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 5, May 1966 p 52-55
(Contract NASw-2037)
(NASA-TT-F-14265) Avail: NTIS CSCL 08M

Measurement of soil moisture using wire wound strip heaters inserted in the soil is recommended as a convenient and accurate method that eliminates collection of soil samples and their tedious processing. Sensors can be packed in soil which is then dried to ensure good contact when the sensors are placed in the field. Author

**N72-21415*#** Becton, Dickinson and Co., Raleigh, N.C.
**VACUUM PROBE SURFACE SAMPLER Patent Application**
Bruce A. Zahlava, inventor (to NASA) Filed 30 Dec. 1971 10 p
(Contract NAS1-9398)
(NASA-Case-LAR-10623-1; US-Patent-Appl-SN-214086) Avail: NTIS CSCL 14B

A vacuum probe surface sampler for rapidly sampling relatively large surface areas which possess relatively light loading densities of microorganisms, drug particles or the like is described. A vacuum head having a hollow handle connected to a suitable vacuum source is frictionally attached to a cone assembly terminating in a flared tip adapted to be passed over the surface to be sampled. A fine mesh screen carried by the vacuum head provides support for a membrane filter which collects the microorganisms or other particles with the head assembly. The head easily removed from the cone assembly without contacting the cone assembly with human hands.
NASA

**N72-21416*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**ORBITAL AND ENTRY TRACKING ACCESSORY FOR GLOBES Patent Application**
Edgar B. Pritchard, inventor (to NASA) Filed 29 Nov. 1971 11 p
(NASA-Case-LAR-10626-1; US-Patent-Appl-SN-202750) Avail: NTIS CSCL 14B

An orbital and entry tracking accessory or attachment is arranged to be mounted on a globe to provide a rapid means of determining range requirements for entry vehicles returning from any orbit to any desired landing site with reasonable accuracy. The device preferably is constructed of clear plastic strip material, and comprises a support ring, a calibrated orbital track member rigidly carried by the support ring, and a calibrated lateral range member pivotally coupled to the support ring at points such that the lateral range member is always oriented normally to the orbital track member. The assembly is mountable on the globe rather snugly, but freely movable. With the device mounted on a globe, and the orbital track member located to simulate a desired orbital track, the lateral range member can be pivotally moved into alignment with a desired landing site on the globe, and the calibrations on the two members permit ready determination of the longitudinal and lateral range requirements from any point of entry along the orbital track. NASA

**N72-21417*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**A FLOW VELOCITY AND DIRECTION INSTRUMENT Patent Application**
Donald L. Maiden, James H. Monteith, and Thomas D. Carpini, inventors (to NASA) Filed 27 Jul. 1971 10 p
(NASA-Case-LAR-10855-1; US-Patent-Appl-SN-166541) Avail: NTIS CSCL 14B

An instrument for providing measurements of both the magnitude and direction of flow velocities in a flow field is described. A probe is oriented in the flow field by two servo systems which impart two angular motions to the probe to aline it with the direction of the flow. The two angular motions are indicative of the direction of flow and the magnitude of the flow velocity is then measured by conventional means. NASA

**N72-21418*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**DEVICE FOR DETERMINING RELATIVE ANGULAR POSITION BETWEEN A SPACECRAFT AND A RADIATION EMITTING CELESTIAL BODY Patent Application**
Winfield H. Farthing and Herbert F. Frisbie, inventors (to NASA) Filed 24 Feb. 1972 22 p
(NASA-Case-GSC-11444-1; US-Patent-Appl-SN-229128) Avail: NTIS CSCL 14B

Signals indicative of the angular position of a spin-stabilized spacecraft, probe, or sounding rocket relative to a radiation-

emitting celestial body are derived with a detector including four electrodes for deriving indications of the centroid of the radiation image on the detector. During each spin of the satellite, each electrode derives a signal with first nonzero level while the detector is not illuminated by the radiation and a second nonzero level while it is illuminated by the radiation. NASA

**N72-21419*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**INFRARED HORIZON LOCATOR Patent Application**
Antony Jalink, Jr., inventor (to NASA) Filed 26 May 1971 13 p
(NASA-Case-LAR-10726-1; US-Patent-Appl-SN-146935) Avail: NTIS CSCL 14B

A precise method and apparatus are described for locating the earth's infrared horizon from space that is independent of season and latitude. First and second integrations of the earth's radiance profile are made from space to earth, with the second delayed with resect to the first. The second integration is multiplied by a predetermined constant R and then compared with the first integration. When the two are equal the horizon is located. NASA

**N72-21420*#** Goodyear Aerospace Corp., Akron, Ohio.
**COMPRESSION TEST ASSEMBLY TO PREVENT BUCKLING OF SMALL DIAMETER SPECIMENS Patent Application**
Anthony H. Kariotis, inventor (to NASA) Filed 25 Feb. 1972 7 p
(Contract NAS1-7522)
(NASA-Case-LAR-10440-1; US-Patent-Appl-SN-229413) Avail: NTIS CSCL 14B

A compression testing assembly which is primarily concerned with preventing buckling of small diameter specimens during compression testing, in order to permit use of commercially available extensometers to measure strain, is described. The equipment enables measurement of strain over a specific gauge length during compression testing of small diameter specimens, and provides: (1) lateral support to prevent buckling; (2) extensometer attachment capability; and (3) automatic specimen alignment. NASA

**N72-21421*#** National Academy of Sciences-National Research Council, Washington, D.C.
**ELECTRON MICROSCOPE APERTURE SYSTEM Patent Application**
Klaus Heinemann, inventor (to NASA) Filed 28 Jan. 1972 17 p Sponsored by NASA
(NASA-Case-ARC-10448-1; US-Patent-Appl-SN-221670) Avail: NTIS CSCL 14B

An electron microscope is described, which includes an electron source, a condenser lens having either a circular aperture for focusing a solid cone of electrons onto a specimen or an annular aperture for focusing a hollow cone of electrons onto the specimen, and an objective lens with an annular objective aperture, for focusing electrons passing through the specimen onto an image plane. The invention also entails a method of making the annular objective aperture, using electron imaging, electrolytic deposition, and ion etching techniques. NASA

**N72-21422*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**INFRARED DETECTORS Patent Application**
Chris Gross and Robert J. Mattauch, inventors (to NASA) (Va. Univ.) Filed 5 Feb. 1971 8 p
(NASA-Case-LAR-10728-1; US-Patent-Appl-SN-112998) Avail: NTIS CSCL 14B

A method for making high quality performance infrared photodetectors, from a semiconductor material is described. The semiconductor material is irradiated with an electron beam to produce defect levels in the material thereby improving the performance of the photodectors. NASA

**N72-21423*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**EXPOSURE INTERLOCK FOR OSCILLOSCOPE CAMERAS Patent Application**
Cary D. Spitzer and Jerry D. Stainback, inventors (to NASA) Filed 11 Nov. 1971 9 p
(NASA-Case-LAR-10319-1; US-Patent-Appl-SN-197870) Avail: NTIS CSCL 14B

A description is given of an exposure interlock for oscilloscope cameras. The interlock cuts off ambient light from the oscilloscope screen before the shutter of the camera is tripped. A flap is provided which may be selectively positioned to an open position which enables viewing of the oscilloscope screen and a closed position which cuts off the oscilloscope screen from view and simultaneously cuts off ambient light from the oscilloscope screen. A mechanical interlock is provided between the flap and shutter trip structure which causes the flap to be activated to its closed position before the camera shutter is tripped, thereby preventing overexposure of the film. NASA

**N72-21424*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**COMBUSTION DETECTOR Patent Application**
Robert L. Trimpi, John E. Nealy, and William L. Grose, inventors (to NASA) Filed 16 Apr. 1971 8 p
(NASA-Case-LAR-10739-1; US-Patent-Appl-SN-134567) Avail: NTIS CSCL 14B

A device has been developed for generating a rapid response signal upon the radiation emitting combustion reaction of certain gases in order to provide a means for the detection and identification of such reaction and concurrently discriminate against spurious signals. This combustion might be the first stage of a coal mine explosion process, and thereby this device could provide a warning of the impending explosion in time to initiate quenching action. This device has the capability of distinguishing between the light emitted from a combustion reaction and the light emitted by miners' lamps, electric lamps, welding sparks, or other spurious events so that the quenching mechanism is triggered only when an explosion initiating combustion occurs. NASA

**N72-21425*#** Scientific Translation Service, Santa Barbara, Calif.
**UTILIZATION OF ATOMIC ABSORPTION SPECTROPHOTOMETRY FOR THE STUDY OF ADSORPTION KINETICS IN THE LIQUID PHASE**
J. Vergnaud, B. Rey-Coruais, and R. Neybon Washington NASA Apr. 1972 9 p refs Transl. into ENGLISH from Bull. Soc. Chim. France (Paris), no. 6, 1967 p 2194-2196
(Contract NASw-2035)
(NASA-TT-F-14263) Avail: NTIS CSCL 14B

Atomic absorption spectrophotometry is a preferred analysis instrument for the continuous measurement of concentration variations of a cation in solution. There is one important application, which is the study of adsorption kinetics in the liquid phase of platinum with respect to adsorbants such as coal or alumina. An instrument which couples the reactor to the spectrophotometer is described. The respose time of this unit is on the order of one second. Thus, if it is difficult to determine the rapid adsorption kinetics such as that of platinum with respect to coal, it is very convenient to study a slow absorption kinetic process such as that of alumina. It is easy to obtain the adsorption velocity at the origin of time using a continuous measurement technique. It is also possible to determine the adsorption limit using discontinuous measurements, which have the advantage of consuming only a very few cations. Author

**N72-21426*#** Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.
**OPTIMIZATION OF A FLUIDIC TEMPERATURE CONTROL DEVICE**
J. M. Zabsky, D. R. Rask, and J. B. Starr Dec. 1970 35 p refs (Contract NAS9-10858)

(NASA-CR-115511; Rept-12233-FR) Avail: NTIS CSCL 14B

Refinements are described to an existing fluidic temperature control system developed under a prior study which modulated temperature at the inlet to the liquid-cooled garment by using existing liquid supply and return lines to transmit signals to a fluidic controller located in the spacecraft. This earlier system produced a limited range of garment inlet temperatures, requiring some bypassing of flow around the suit to make the astronaut comfortable at rest conditions. Refinements were based on a flow visualization study of the key element in the fluidic controller: the fluidic mixing valve. The valve's mixing-ratio range was achieved by making five key changes: (1) geometrical changes to the valve; (2) attenuation of noise generated in proportional amplifier cascades; (3) elimination of vortices at the exit of the fluidic mixing valve; (4) reduction of internal heat transfer; and (5) flow balancing through venting. As a result, the refined system is capable of modulating garment inlet temperature from 45 F to 70 F with a single manual control valve in series with the garment. This control valve signals without changing or bypassing flow through the garment. Author

*N72-21427*#* Barnes Engineering Co., Stamford, Conn.

**DEVELOPMENT OF IMPROVED PYROELECTRIC DETECTORS. MEASUREMENTS OF PYROELECTRIC MATERIAL CHARACTERISTICS AND FET CHARACTERISTICS Quarterly Technical Report, 23 Nov. 1971 - 22 Feb. 1972**

*Seymour Weiner, Henry P. Beerman, and Frank C. Schwarz* 29 Feb. 1971 87 p refs

(Contract NAS5-21655)

(NASA-CR-122382; BEC-2064QR2) Avail: NTIS CSCL 14B

Research was undertaken to improve the detectivity of the pyroelectric detector with the ultimate goal of operation at or near the temperature-noise limit. Two general areas of investigation were undertaken: (1) to improve responsivity through the use of new materials; and (2) to reduce noise through improved field effect transistor characteristics, and improved electroding of the pyroelectric material. FET's are being obtained from various manufacturers, evaulated, and selected units tested for evaluation of characteristics critical to their use as preamplifiers with pyroelectric detectors. Author

**N72-21428*#** Battelle Memorial Inst., Columbus, Ohio.

**IMPROVEMENT OF A LARGE-AMPLITUDE SINUSOIDAL PRESSURE GENERATOR FOR DYNAMIC CALIBRATION OF PRESSURE TRANSDUCERS**

Richard E. Robinson Feb. 1972 31 p refs

(Contract NAS3-11229)

(NASA-CR-120874) Avail: NTIS CSCL 14B

Results of research on the improvement of a sinusoidal pressure generator are presented. The generator is an inlet-area-modulated, gas-flow-through device (siren type) which was developed to dynamically calibrate pressure transducers and pressure probes. Tests were performed over a frequency range of 100 Hz to 20 kHz at average chamber pressures (bias pressure) between 30 and 50 psia (21 and 35 N/sq cm abs) and between 150 and 300 psia (104 and 207 N/sq cm abs). Significant improvements in oscillation pressure waveform were obtained but with reduction in available generator oscillation pressure amplitude range. Oscillation pressure amplitude, waveform, and waveform spectral content are given as functions of frequency for the two bias pressure conditions. The generator and instrumentation for frequency, amplitude, and spectrum measurements are described. Author

**N72-21429*#** Martin Marietta Corp., Orlando, Fla. Advanced Technology Dept.

**TEMPERATURE MEASUREMENT SYSTEM Patent Application**

Forest C. Deal, inventor (to NASA) Filed 17 Dec. 1971 11 p Sponsored by NASA

(NASA-Case-MFS-20781; US-Patent-Appl-SN-209145) Avail: NTIS CSCL 14B

A temperature measurement system of the radiometer type is described. Infrared radiation from a heated body is filtered to provide two distinct bands of radiation and electrical signals representative of the magnitude of each band are applied to a ratio circuit. The circuit provides an electrical output representative of the temperature of the body. NASA

**N72-21430*#** National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

**PRESSURE SENSITIVE TRANSDUCER Patent Application**

Wilhelm Rindner, Americo A. Iannini, and Andre Garfein, inventors (to NASA) Filed 23 Nov. 1970 11 p

(NASA-Case-ERC-10087-2; US-Patent-Appl-SN-91642) Avail: NTIS CSCL 14B

A description is given of a miniature electromechanical junction transducer, the operation of which is based on piezojunction effect. The mechanical imput coupling member is formed in situ and is spread over the top of the mesa structure to form an exact duplicate of the mesa surface at the area of contact. NASA

**N72-21431*#** North American Rockwell Corp., Downey, Calif.

**AIRCRAFT CRASH LOCATOR APPARATUS Patent Application**

Robert Manoli and Bertram R. Ulrich, inventors (to NASA) Filed 20 Oct. 1970 12 p Sponsored by NASA

(NASA-Case-MFS-16609; US-Patent-Appl-SN-82279) Avail: NTIS CSCL 14B

An aircraft crash locator apparatus mounted on the tail of an aircraft in a round sealed case held by a shear pin which releases under crash impact of 7 to 8 G's is described. The transmitter is powered by a battery which is kept charged by a trickle charge from the navigational light on the tail. The battery has a button actuated meter to test the battery condition while the apparatus is installed on the aircraft. At the time of the crash, the transmitter is released and ejected, the yoyo antenna wound around the case unwinds, and the transmitter starts emitting on emergency frequencies 121.5 MHz and 243 MHz. The transmitter, which is shock mounted in a double plastic case, lands and continues transmitting for about 48 hours. NASA

**N72-21432*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**FAST SCAN CONTROL FOR DEFLECTION TYPE MASS SPECTROMETERS Patent Application**

Paul R. Yeager, Gianni Gaetano, and David B. Hughes, inventors (to NASA) (Bell and Howell Co.) Filed 13 Oct. 1971 15 p

(NASA-Case-LAR-10766-1; US-Patent-Appl-SN-188836) Avail: NTIS CSCL 14B

A high speed scan device allows scanning sector mass spectrometer to measure mass of preselected gases at a very high sampling rate. The device generates a rapidly changing staircase output which is applied to the accelerator of the spectrometer. It also generates defocusing pulses that are applied to one of the deflecting plates of the spectrometer, which, when shorted to ground, deflects the ion beam away from the collector. A defocusing pulse occurs each time there is a change in the staircase output. NASA

**N72-21433*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**GAS CHROMATOGRAPH INJECTION SYSTEM Patent Application**

Glenn E. Pollock, Milton E. Henderson, and Ralph W. Donaldson, Jr., inventors (to NASA) Filed 16 Sep. 1971 13 p

(NASA-Case-ARC-10344-1; US-Patent-Appl-SN-180962) Avail: NTIS CSCL 14B

An injection system for a gas chromatograph is described. The system uses a chamber for the reception of the sample. The chamber is kept at low temperature and is unpressurized. The sample is placed in the chamber and the solvent is removed by evaporation. The chamber is closed, the sample is volatilized, and

a carrier gas injects the sample into the analysis apparatus. NASA

**N72-21434*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**INTERFEROMETRIC ROTATION SENSOR** *Patent Application*
Thomas M. Walsh, inventor (to NASA) Filed 21 Jun. 1971 23 p
(NASA-Case-ARC-10278-1; US-Patent-Appl-SN-154933) Avail: NTIS CSCL 14B

An interferometric rotation sensor and control system is described which includes a compound prism interferometer and an associated direction control system. Light entering the interferometer is split into two paths with the light in the respective paths being reflected an unequal number of times and then being recombined at an exit aperture in phase differing relationship. Incoming light deviating from the optical axis of the device by an angle alpha causes a similar displacement of the two component images at the exit aperture with the result being that a fringe pattern is developed with the number of fringes being directly related to the angle alpha. Various control systems incorporating the interferometer are also discussed. NASA

**N72-21435*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**APPARATUS FOR VIBRATIONAL TESTING OF ARTICLES** *Patent Application*
James J. Kerley, Jr. and Norman G. Schaller, inventors (to NASA) Filed 3 Aug. 1971 34 p
(NASA-Case-GSC-11302-1; US-Patent-Appl-SN-168650) Avail: NTIS CSCL 14B

Equipment is described for vibrational testing of manufactured assemblies, components, and other articles. The apparatus consists of a vibration table having a generally planar supporting surface for the article being tested, at least a pair of actuating pistons for effecting vibrational movement of the table along a primary axis generally perpendicular to the plane of the supporting surface, at least one further actuating piston for effecting transverse vibration of the table generally in the plane of the supporting surface, and a plurality of pairs of prestressed supporting cables for securing the table to a peripheral stationary frame. The test equipment may also be mounted on a testing centrifuge for adding an essentially constant gravitational accelerating force to the vibrational forces acting on the article being tested. NASA

**N72-21436#** Los Alamos Scientific Lab., N.Mex.
**HRS SPECTROMETER SYSTEM. PART 1: CONCEPTS AND DESIGN**
B. Zeidman Oct. 1971 48 p refs
(Contract W-7405-eng-36)
(LA-4773-Pt-1) Avail: NTIS

Specifications for the proposed magnetic proton spectrometer facility for the Los Alamos Meson Physics Facility are presented. The analyzer utilizes a quadrupole-dipole-dipole arrangement with a mean radius or curvature of 3.5 meters so that 800-MeV prorons can be analyzed at 14 kG. Research proposals for the facility are summarized. NSA

**N72-21437#** Sandia Labs., Albuquerque, N.Mex.
**DYNAMICS OF A GYROSCOPE ON AN ELASTIC SUSPENSION**
V. P. Burmistrov, G. M. Vinogradov, and E. M. Rodionov 1971 10 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Priborostr. (Leningrad), v. 14, no. 3, 1971 p 70-74
(SC-T-713086) Avail: NTIS

Equations of motion for a gyroscope on an elastic suspension are derived from Euler equations allowing for rotating of the casing, and the results are plotted graphically. Practical recommendations are given for determining compensation of forces on the elastic suspension. Author

**N72-21438#** Oak Ridge National Lab., Tenn.
**RADIOLOGICAL INSTRUMENT DESIGN INVESTIGATION FOR OCD Annual Report, Jan. - Oct. 1970**
J. T. Delorenzo, F. M. Glass, E. J. Kennedy, F. W. Manning, J. M. Rochelle, H. N. Wilson, and R. E. Zedler 31 Mar. 1971 49 p refs Sponsored by AEC
(ORNL-TM-3370) Avail: NTIS

Miniature gas discharge ionization chamber instruments were studied, and two experimental modules were constructed and tested. Additional observations and data were recorded to determine radiation effects on metal oxide field effect transistors. A low power, solid state electrometer circuit constructed in module form was investigated, and an experimental instrument was constructed by combining the meter, ionization chamber, and packaging of a model CD V-715 instrument with the electrometer circuit module. It is estimated that this instrument, if engineered for production, could be produced for about $75 each in quantities of 10,000. The production cost of the 1962 model was $25-$30. A commercial operational amplifier was studied for application to electrometer type radiological instruments. Also, a study of proportional counters for use in OCD gamma survey meters was started. Utilization of breadboard-type integrated circuits was investigated.
Author (NSA)

**N72-21439#** Commissariat a l'Energie Atomique, Saclay (France). Centre D'Etudes Nucleaires.
**VERY-HIGH-RESOLUTION NONDISPERSIVE X-RAY SPECTROMETRY WITH COOLED SI(LI) DETECTORS AND OPTOELECTRON PREAMPLIFIER [SPECTROMETRIE X NON DISPERSIVE A TRES HAUTE RESOLUTION AVEC DETECTEURS SI(LI) ET PREAMPLIFICATEUR OPTOELECTRONIQUE REFROIDS]**
Alain Friant May 1971 11 p refs In FRENCH Presented at Intern. Conf. on X-ray Anal. Methods, Toulouse, 6-10 sep. 1971
(CEA-CONF-1840; Conf-710937-1) Avail: AEC Depository Libraries

Nondispersive X-ray spectrometers allow the simultaneous analysis of all the lines present, with a resolution higher than any other pulse detector. The quality of the silicon used has been greatly improved. Optoelectron feedback preamplifiers whose resolution reaches a hundred eV have been developed. NSA

**N72-21440#** General Electric Co., Philadelphia, Pa. Space Div.
**RESEARCH ON AVALANCHE TYPE SEMICONDUCTOR RADIATION DETECTORS Semiannual Report, Jan. - Jun. 1971**
Philip J. Moldofsky and Peter V. Hewka Jul. 1971 58 p
(Contract AT(30-1)-3246)
(NYO-3246-TA-9) Avail: NTIS

The detection capabilities of this probe are described in terms of level of sensitivity, angular uniformity of sensitivity, and the minimum detectable amount (MDA) capability for plutonium detection Pu-238 and Pu-239 under given assumptions of physiology and test procedure. Also, the first detectors fabricated from specially modified Czochralski-growth silicon are described. Uniformity of resistivity and gain over detectors with surface area of 7 sq mm was demonstrated by the improved energy resolution. Attempts to incorporate this silicon and Czochralski silicon which operates at higher voltages and gains, grown with a relatively flat liquid-solid interface, into plutonium detector designs are discussed. The silicon uniformity studies are discussed. A fast-electronics signal processing system to follow the avalanche detector was assembled to take advantage of the fast response time of the detector in the reduction of noise. A significant decrease in system noise is reported with the concurrent increase in detection efficiency permitted by the lower threshold resulting from lower noise. Author (NSA)

**N72-21441#** Battelle-Northwest, Richland, Wash.
**POSITION SENSITIVE PROPORTIONAL COUNTER FOR NEUTRON RADIOGRAPHY**
K. L. Swinth and J. C. Crowe [1971] 15 p refs Presented at

Nucl. Sci. Symp., San Francisco, 3 Nov. 1971
(Contract AT(45-1)-1830)
(BNWL-SA-3936; Conf-711111-12) Avail: NTIS

A prototype position sensitive proportional counter was investigated for use in neutron imaging applications. The counter uses a converter foil of Li6F and a collimation grid to achieve improved resolution compared to counters filled with a neutron sensitive counting gas. The proportional counter consists of a grid of 36 1-mil pyrolytic carbon coated quartz fibers on 2.5 centers. Because of the high resistance of the collector wires and the distributed capacitance to ground, the rise time of a pulse will increase with distance along the collector. This rise-time information is used to determine the position of an event to accuracies less than 1 mm along the wire. Standard nuclear instrumentation techniques are utilized with readout on a multichannel pulse height analyzer or on a storage scope. Tests performed with alpha particles showed that a geometry using collector wires off center by 0.5 mm produced the best resolution. Author (NSA)

**N72-21442#** Maryland Univ., College Park. Dept. of Chemistry.
**USE OF POSITION-SENSITIVE SEMI-CONDUCTOR DETECTORS IN THE STUDY OF HEAVY ELEMENT NUCLEAR REACTIONS**
M. M. Minor, A. E. Salwin, V. E. Viola, Jr., R. B. Theus (NRL, Washington, D. C.), and R. O. Bondelid (NRL, Washinton, D. C.) Aug. 1971 32 p refs Sponsored in part by Navy
(Contract AT(40-1)-3783)
(MNC-3783-10) Avail: NTIS

The application of position-sensitive semiconductor detectors to the study of heavy element nuclear reactions at intermediate energies is described. Experimental procedures and results are presented for the use of these devices in the following types of measurements: (1) binary fission fragment angular correlations; (2) fission fragment angular distributions; (3) kinetic energy release in fission; and (4) spallation recoil product angular distributions. The position-sensitive detectors are found to provide much improved experimental efficiency over normal semiconductor detectors in experiments where the angular dependence of the products is quite rapid; e.g., fission fragment angular correlations and spallation recoil angular distributions. For experiments in which the product counting rates vary slowly with angle, such as fission fragment angular distributions, the position detector is much less useful. Although the energy resolution of these devices is poorer than normal detectors, they are advantageous in experiments designed to study fission energetics as a function of reaction kinematics.
Author (NSA)

**N72-21443#** Du Pont de Nemours (E. I) and Co., Aiken, S.C.
**DIGITAL DATA ACQUISITION AND CONTROL FOR A MASS SPECTROMETER**
J. S. Byrd Oct. 1971 11 p
(Contract AT(07-2)-1)
(DP-1175) Avail: NTIS

A digital system has been built to automatically punch mass spectrometer data on IBM cards for computer processing and also to control the acceleration potential of the spectrometer. The system can be operated in two scan control modes with the mass spectrometer, and a data logging mode is provided for other laboratory applications. Author (NSA)

**N72-21444#** Institut d'Astrophysique, Liege (Belgium).
**DESCRIPTION OF AN OUT-OF-PLANE INVERTED WADSWORTH SPECTROGRAPH FOR USE ONBOARD CENTAUR SOUNDING ROCKET**
J.-M. Ureux Paris ESRO Jun. 1971 30 p refs In FRENCH; ENGLISH summary
(ESRO-SM-80) Avail: NTIS

The aim of experiment R-10 (payloads C-52/1 and C-52/2) was to obtain spectrophotographic recording of auroral emissions from a sounding rocket on ballistic trajectory. A description of the solutions adopted for the development of the apparatus is given. Some problems which arose during the implementation of the program required complementary equipments to be provided for, which are also reviewed. Author (ESRO)

**N72-21445#** Kiruna Geophysical Observatory (Sweden).
**INFRASOUND RECORDING EQUIPMENT AT KIRUNA GEOPHYSICAL OBSERVATORY**
Ludwik Liszka, Sixten Olsson, Kjell Englund, and Knut Koskenniemi Dec. 1971 26 p refs Sponsored in part by the Swed. Natl. Council of Nat. Sci.
(KGO-TR-71-105) Avail: NTIS

A technical description of equipment for detection and recording of infrasound at 2 Hz is given and some examples of recordings are shown. Two small tripartite arrays with three microphones each are used with a spacing of 2 km between the arrays. A correlator with two microphones spaced 60 m apart on a rotating boom is also used. Each of the tripartite arrays is operated with two phase comparators which use zero crossing comparison technique, while the correlator uses the one-bit correlation technique and has the features of an gate. A direction discriminator compares the phase at two sets of NS microphones and two sets of EW microphones and the amplitude of the signal. When the signals are close in phase, i.e. come from the same direction at both arrays and have sufficient amplitude, a digital pen-recording is given. Author (ESRO)

**N72-21446#** Institut Franco-Allemand de Recherches, St. Louis (France).
**PRELIMINARY TESTS IN VIEW OF THE USE OF A DIFFERENTIAL INTERFEROMETER FOR STUDYING THE SHOTS OF MODELS IN DETONATABLE GAS MIXTURES [VORVERSUCHE ZUM EINSATZ DES DIFFERENTIAL-INTERFEROMETERS BEIM EINSCHUSS VON MODELLEN IN REAKTIONSFAEHIGE GASE]**
H. F. Lehr and R. Maurer 10 Jul. 1971 39 p refs In GERMAN
(ISL-7/70) Avail: NTIS

The application of a differential interferometer to study shock-induced combustion of a detonatable gas mixture by a hypervelocity projectile is discussed. It is shown that interferograms recorded during tests are clearer than schlieren and shadow photographs. The method is ideally suited for deciding whether reactions will take place. It can also be used to determine pressure distribution with accuracy and reproducibility. Tests were carried out with sharp conical projectiles. ESRO

**N72-21447#** Transportation Systems Center, Cambridge, Mass.
**OCCUPANT MOTION SENSORS: METHODS OF DETECTION AND ANALYSIS**
J. L. Horner, D. S. Ofsevit, G. R. Plank, and G. G. Lawrence Jul. 1971 59 p refs
(PB-204809; DOT-TSC-NHTSA-71-4) Avail: NTIS CSCL 13L

A study has been made of methods for measuring occupant motion within a vehicle during crash or impact conditions. The purpose of the measurements is to evaluate restraint systems, using anthropometric dummy, animal, or human occupants. A list of general specifications for occupant motion sensors was drawn up. This was used to establish criteria for evaluation of proposed systems. From a study of various possible systems, five were selected for further development. These systems were built and prepared for field testing. Author (GRA)

**N72-21448#** Transportation Systems Center, Cambridge, Mass.
**OCCUPANT MOTION SENSORS Technical Report, Jul. 1970 - Jan. 1971**
Joseph L. Horner Mar. 1971 55 p refs
(PB-204808; DOT-TSC-NHSB-71-1) Avail: NTIS CSCL 13L

An analysis has been made of methods for measuring vehicle occupant motion during crash or impact conditions. The purpose of the measurements is to evaluate restraint system performance using human, anthropometric dummy, or animal occupants. A detailed Fourier frequency analysis is made of the

sensor requirements. Potential candidate systems are evaluated, and five of these recommended for further development and field testing. Author (GRA)

**N72-21449#** Transportation Systems Center, Cambridge, Mass.
**DEVELOPMENT OF ANTICIPATORY AUTOMOBILE CRASH SENSORS Annual Report, 1 Jul. 1970 - 30 Jun. 1971**
John B. Hopkins, F. Ross Holmstrom, Edward G. Apgar, Morrin E. Hazel, and A. Timothy Newfell 30 Jun. 1971 104 p refs
(PB-204806; DOT-TSC-NHTSA-71-3) Avail: NTIS CSCL 13L

A comprehensive examination was carried out to determine the basic system constraints and required operational characteristics for anticipatory sensing of impending automobile crashes. This was followed by consideration of a wide variety of possible sensing techniques and selection of those deserving of further study. Two methods were chosen, microwave radar and ultrasonic sonar, and the advantages, weaknesses, and uncertain areas of both are delineated. Author (GRA)

**N72-21450#** Transportation Systems Center, Cambridge, Mass.
**AUTOMATIC DATA REDUCTION FROM AERIAL PHOTOGRAPHS**
Juris G. Raudseps and David S. Prerau Aug. 1971 221 p
(PB-204810; DOT-TSC-FHWA-71-1) Avail: NTIS CSCL 13B

The report deals with the problem of automatically extracting data about highway traffic flow from sequences of aerial photographs. The problem being attacked is to develop techniques to decrease the cost and time involved in reducing the traffic data contained in aerial photographs to usable form.
Author (GRA)

**N72-21451#** Transportation Systems Center, Cambridge, Mass.
**TWO CANDIDATE SYSTEMS FOR UNMANNED FOG BANK DETECTION**
Jack R. Lifsitz and Hector C. Ingrao Jun. 1971 131 p refs
(PB-204805; DOT-TSC-CG-71-3) Avail: NTIS CSCL 04B

The detection of coastal fog banks by remote sensing methods is discussed. The feasibility of laser backscattering (lidar) and infrared radiometry is explored in detail. These techniques are analyzed theoretically and experimental data are presented supporting the analysis. A design study is carried out for several laser systems, considering safety, reliability, cost, convenience, efficiency and maximum range. A fog bank detector utilizing a GaAs laser array is described which best satisfies these criteria. In addition to clarifying several critical questions underlying the lidar design, the proposed test program would allow further evaluation of the infrared radiometric method. The latter technique, if its reliability can be verified, offers the advantages of being simpler and less expensive for fog bank detection than the lidar method. Author (GRA)

**N72-21452#** Transportation Systems Center, Cambridge, Mass.
**SURVEY OF METEOROLOGICAL REMOTE SENSORS Technical Report, 1 Jul. 1970 - 15 May 1971**
A. E. Barrington 15 May 1971 16 p refs
(PB-204793; DOT-TSC-CG-71-1) Avail: NTIS CSCL 04B

The preliminary results of a survey are presented which identify techniques for determining meteorological data by remote sensing, applicable to automatic data buoy platforms. Both passive and active techniques are reviewed with emphasis on the former, in view of their more advanced development status. The principal references listed in the bibliography section of the memorandum indicate that experimental data to date have been obtained using only stable instrument platforms in a clean environment. Operation on unstable instrument platforms in the severe ocean environment requires further study. Author (GRA)

**N72-21453#** Cornell Univ., Ithaca, N.Y. Materials Science Center.
**DEVELOPMENT OF MECHANICALLY STABLE, THERMALLY CYCLICABLE POINT CONTACTS FOR USE IN SUPERCONDUCTING DEVICES M.S. Thesis**
Stephen Frederick Strait Aug. 1971 55 p refs
(Contract N00014-67-A-0077-0016; NR Proj. 319-032)
(AD-735501; MSC-1636; TR-5) Avail: NTIS CSCL 14/2

Mechanically stable superconducting point contacts are developed which are unaltered by repeated thermal cyclings to liquid helium temperatures and which have a long shelf life. Their response to temperature, capacitance, radiation and magnetic fields is investigated with applications to superconducting measuring devices. Author (GRA)

**N72-21454#** Air Force Eastern Test Range, Patrick AFB, Fla.
**AFETR INSTRUMENTATION HANDBOOK**
Sep. 1971 314 p Supercedes report AFETR-TR-68-5
(AD-735263; AFETR-TR-71-5) Avail: NTIS HC $6.00/MF $0.95 CSCL 16/1

The handbook describes ETR instrumentation used to obtain data from missile and space flight tests. The Data Acquisition Section covers instrumentation for observing flight performance, receiving telemetered data, and measuring flight paths. The Support Section describes equipment used to sequence prelaunch operations, control range instrumentation, and identify times of events. The Range Safety Section describes equipment used to monitor the Range area before launch, to observe deviations from planned flight paths, and to terminate a flight when required. The Ships and Aircraft Section identifies the data acquisition support instrumentation installed on various types of range ships and aircraft. The ETR Stations Section summarizes the on site. Author (GRA)

**N72-21455#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**A METHOD FOR DETERMINING THE COEFFICIENT OF DYNAMIC VISCOSITY OF A LIQUID**
K. Sh. Latipov and B. A. Musabaev 30 Nov. 1971 12 p refs
Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Tekh. Nauk (Tashkent), v. 12, no. 1, 1968 p 58-61
(AD-735640; FTD-HT-23-1310-71) Avail: NTIS CSCL 14/2

The method is based on the measurement of the speed of a plate moving on the surface of the studied liquid. The theory of the motion of a viscous liquid, which occupies the space between 2 horizontal planes having a distance h between one another, is considered. An experimental arrangement is described which measures the parameters of a given relation. The experiments were carried out with spindle oil, glycerol, and machine oil. Control measurements were made using the Engler method. GRA

**N72-21456#** Illinois Univ., Urbana. Savoy Aviation Research Lab.
**A NEW APPROACH TO MOTION RELATIONS FOR FLIGHT DIRECTOR DISPLAYS**
Steven L. Johnson, Robert C. Williges, and Stanley N. Roscoe Oct. 1971 27 p refs
(Contracts N00014-67-A-0305-0014; F44620-70-C-0105)
(AD-735916; ARL-71-20; ONR-71-3; AFOSR-71-6) Avail: NTIS CSCL 01/4

Two new approaches to the problem of preferred motion relationships for attitude displays were explored: a time-lagged frequency-separated kinalog display and a hybrid frequency-separated presentation employed aileron position to quicken the indication of bank attitude changes. Eight flight director display configurations that encompassed the combinations of four attitude presentations (moving horizon, moving airplane, kinalog, and frequency-separated) and two modes of command presentation (pursuit and compensatory) were compared in a Link GAT-2 flight trainer. Author (GRA)

**N72-21457#** TRW Systems Group, Redondo Beach, Calif.
**DEVELOPMENT OF LASER INSTRUMENTATION FOR PARTICLE MEASUREMENT Final Report**
B. J. Matthews and R. F. Kemp Jun. 1971 72 p refs

(Contract CPA-70-4)
(PB-205189; TRW-14103-6003-R000; APTD-0870) Avail: NTIS CSCL 14E

The report summarizes recent developments in laser-illuminated instrumentation for measuring particulate density distributions in an operating coal-fired steam boiler. The work is a continuation of a previous effort which was concerned with applying single beam (Gabor) pulsed ruby laser holography to the recording of particulates over extreme distances. The present work attempts to determine if limestone dust in the presence of flyash background could be recorded holographically via back or side scattering of a ruby laser beam. To investigate the feasibility of making holograms of side or back scattering of making holograms of side or back scattering of a ruby laser beam, a mathematical model was first derived. This model related 4 factors which gives the transmittance along the scattering path from the laser to a detector and allows analysis of experimental measurements. GRA

**N72-21458#** Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
**THE FEASIBILITY OF USING COLOR AERIAL PHOTOGRAPHY TO DETECT AND EVALUATE SULPHUR DIOXIDE INJURY TO TIMBER STANDS**
Kristina A. Zealer, Robert C. Heller, Nancy X. Norick, and Marilyn Wilkes Nov. 1971 160 p refs
(PB-205279; APTD-0865) Avail: NTIS CSCL 06F

A feasibility study was undertaken near a point source of sulphur dioxide, emissions to determine the best film-filter-scale combination of aerial photography to evaluate SO2 injury to forest vegetation. Normal color film, exposed through a didymium filter, at very large scales (1:800 and 1:1,584) proved to be the most accurate sensor. Color infrared film was almost as good. Interpreter differences were least at large scale and on color film. Ground variables which were best correlated with photo interpretation were: crown color, needle color, Munsell hue, percent of current needles with tip dieback and the length of the tip dieback. A combination of photo and ground plots appears to be the most efficient design for measuring these effects-especially if done over large areas. GRA

**N72-21459#** California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
**A SMALL, FAST-RESPONSE PROBE TO MEASURE DENSITY**
G. L. Brown and M. R. Rebollo 13 Sep. 1971 19 p refs
(AD-735954) Avail: NTIS CSCL 14/2

The work arose from a need to measure density in a variable density plane turbulent mixing layer between two different gas streams, usually nitrogen and helium. A small sampling volume, an output independent of the velocity of the fluid relative to the probe, and a response time of milli-seconds or less were essential requirements to be met. Probe design and testing are discussed. GRA

**N72-21460#** Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
**THE EFFECT OF CONE ANGLE ON PENETRATION RESISTANCE**
Edward A. Nowatzki and Leslie L. Karafiath Jan. 1972 31 p refs Presented at the Ann. Meeting of Highway Res. Board, Washington, D. C., 17-21 Jan. 1972
(AD-735788; RM-532J) Avail: NTIS CSCL 14/2

Cone penetrometers offer a relatively quick and simple method of measuring in situ soil strength properties. Despite the wide use of cone penetrometers, only approximate theories are available to evaluate the shear strength parameters from the measured cone penetration resistance or 'cone index'. In this memorandum a theoretical analysis, based on the numerical solution of the differential equations of plasticity, is presented that takes into account correctly both the axial symmetry and the friction at the surface of the cone. The resistance of penetrometers having various cone apex angles is determined by this method for a range of soil properties. The computed cone indices are compared with those measured in the laboratory. Author (GRA)

**N72-21461#** ARO, Inc., Arnold Air Force Station, Tenn.
**EVALUATION OF PROBES FOR MEASURING STATIC PRESSURE IN SUPERSONIC AND HYPERSONIC FLOWS Final Report, Jul. - Oct. 1970**
J. Don Gray AEDC Jan. 1972 44 p refs
(Contract F40600-72-C-0003; AF Proj. 8219)
(AD-736017; ARO-VKF-TR-71-212; AEDC-TR-71-265) Avail: NTIS CSCL 14/2

Pertinent facts in the literature have been examined regarding the aerodynamic characteristics of static-pressure measuring probes in order to assess the relative merits and limitations of cone-cylinder, sharp-cone, and planar disk problems. The effects of Mach number, angle of attack, orifice location, and Reynolds number on the inferred local pressures were all evaluated at Mach numbers up to 8. It is concluded that the planar probe and sharp-cone probe if properly designed are equally more accurate than the cone-cylinder probe at supersonic and hypersonic speeds. However, the cone-cylinder is judged to be superior for use at Mach numbers below 4. Details of a recommended procedure to correct for the effects of viscous interaction all probes and angle of attack planar probes only are included. Author (GRA)

**N72-21747#** Bell Telephone Labs., Inc., Murray Hill, N.J.
**ION NEUTRALIZATION SPECTROSCOPY**
H. D. Hagstrum *In* NBS Electron Density of States Dec. 1971 p 349-357 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

**N72-21902#** Reynolds Metals Co., Richmond, Va. Metallurgical Research Div.
**PROGRESS TOWARD STANDARIZATION OF SCC TEST TECHNIQUES BY THE AMERICAN SOCIETY FOR TESTING AND MATERIALS**
H. Lee Craig, Jr. *In* AGARD Specialist's Meeting on Stress Corrosion Testing Methods Jan. 1972 10 p (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

**N72-21903#** Aluminum Co. of America, Pittsburgh, Pa. Chemical Metallurgy Div.
**PROGRESS TOWARD STANDARDIZATION OF SCC TEST TECHNIQUES BY THE NATIONAL ASSOCIATION OF CORROSION ENGINEERS AND THE ALUMINUM ASSOCIATION**
Donald O. Sprowls *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 20 p (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

**N72-21904#** Newcastle-upon-Tyne Univ. (England). Dept. of Metallurgy.
**STRESS CORROSION TEST METHODS: THE EUROPEAN FEDERATION OF CORROSION CONTRIBUTION**
R. N. Parkins *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 7 p (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

**N72-21905*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**SOME IMPORTANT CONSIDERATIONS IN THE DEVELOPMENT OF STRESS CORROSION CRACKING TEST METHODS**
R. P. Wei (Lehigh Univ.), S. R. Novak (US Steel Corp., Monroeville, Pa.), and D. P. Williams *In* AGARD Specialists

Meeting on Stress Corrosion Testing Methods Jan. 1972 10 p refs (See N72-21900 12-32)
(Contract N00014-68-A-0514)
(NASA-TM-X-68303) Avail: NTIS CSCL 14B

N72-21910# Welding Inst., Cambridge (England).
**STRESS CORROSION TESTING OF WELDED JOINTS**
T. G. Gooch *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 7 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

N72-21911# Department of Energy, Mines and Resources, Ottawa (Ontario). Corrosion Section.
**SCREENING TESTS OF SUSCEPTIBILITY TO STRESS CORROSION CRACKING**
G. J. Biefer and J. G. Garrison *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 9 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

N72-21916# North American Rockwell Corp., Thousand Oaks, Calif. Science Center.
**AN ULTRA HIGH VACUUM SYSTEM FOR DETERMINING THE EFFECTS OF GASEOUS ENVIRONMENTS ON FATIGUE AND FRACTURE PROPERTIES OF METALS**
H. L. Marcus and P. J. Stocker *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 8 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

N72-21917# Ohio State Univ., Columbus. Dept. of Metallurgical Engineering.
**ACOUSTIC EMISSIONS AND SLOW CRACK GROWTH IN HIGH STRENGTH STEEL**
R. W. Staehle and G. E. Kerns *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 12 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

N72-21918# FIAT S.p.A., Turin (Italy). Lab. Auto Avio.
**A CONTRIBUTION TO STRESS CORROSION TESTING OF ALUMINUM ALLOYS**
Giovanni Bollani *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 13 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

N72-21921# Societe Nationale Industrielle Aerospatiale, Paris (France).
**PARTICIPATION OF THE STUDY OF CORROSION UNDER TENSION OF CERTAIN HIGH RESISTANCE ALUMINUM ALLOYS [PARTICIPATION A L'ETUDE DE LA CORROSION SOUS TENSION DE CERTAINS ALLIAGES D'ALUMINUM A HAUTE RESISTANCE]**
Robert Doste *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 15 p In FRENCH (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

# 15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication; friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N72-21462* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**POSITIONING MECHANISM Patent**
Kenneth G. Johnson, inventor (to NASA) Issued 26 Oct. 1971 6 p Field 7 Aug. 1969 Supersedes N70-11162 (08 - 01, p 104) Sponsored by NASA
(NASA-Case-NPO-10679; US-Patent-3,614,898; US-Patent-Appl-SN-848282; US-Patent-Class-74-89.15) Avail: US Patent Office CSCL 13I

A positioning mechanism is described for converting translatory motion into rotary motion. It is designed for extreme accuracy and is suitable for use with precision instrumentation. The mechanism consists of a lead screw mounted with a threaded carriage. A sector is pivotally connected about a fixed axis, normal to the axis of the screw, and is fastened to the carriage by a pair of flexible bands. The sector has a means of adjustment for maintaining each of the bands in a taut condition between the carriage and the sector. Upon translatory movement of the carriage by rotation of the screw, the sector is drawn about its pivot by the carriage via the bands. Because the bands are positioned so that at least one is under tension at all times, the sector can be rotated in either direction without any lost motion or play. D.L.G.

N72-21463* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**MECHANICALLY ACTUATED TRIGGERED HAND Patent**
Dan H. Dane, inventor (to NASA) Issued 16 Nov. 1971 6 p Filed 3 Sep. 1970
(NASA-Case-MFS-20413; US-Patent-3,620,095; US-Patent-Appl-SN-69209; US-Patent-Class-74-469) Avail: US Patent Office CSCL 13I

A mechanically actuated hand is described that can grasp an object like a trigger-actuated tool and depress the trigger of the tool. The hand includes a supporting frame, a pair of jaw members slidably mounted on the frame, and a drive assembly slidably mounted on the frame and mechanically coupled to the jaw members for permitting movement along the frame. A trigger device mounted in each jaw member is connected by a mechanical linkage to the drive assembly so as to be actuated. A brake mechanism is mounted on the frame adjacent each jaw member for selectively immobilizing the jaw members. A touch control device mounted in each jaw member is actuated by a predetermined contact force with an object being grasped and the touch control in turn actuates the brake mechanism to immobilize the jaw member relative to the frame.
Official Gazette of the U.S. Patent Office

N72-21464* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**METHOD AND APPARATUS FOR SWEPT-FREQUENCY IMPEDANCE MEASUREMENTS OF WELDS Patent**
Lester Feinstein and Ronald J. Hruby, inventors (to NASA) Issued 30 Nov. 1971 8 p Filed 31 Dec. 1969 Supersedes N70-22267 (08 - 09, p 1642)
(NASA-Case-ARC-10176-1; US-Patent-3,624,496; US-Patent-Appl-SN-889583; US-Patent-Class-324-71R; US-Patent-Class-324-57R; US-Patent-Class-324-64) Avail: US Patent Office CSCL 13E

A method and apparatus are described for testing integrated circuit microtab welds. A set of reference signatures is prepared for a set of welds of known characteristics and then a signature obtained from a tested weld is compared to the reference

signatures to evaluate the integrity of the tested weld. The reference and test signatures are obtained by passing high frequency electric signals through the various welded structures and sweeping the frequency thereof through the resonance frequencies of the welds. In-phase and quadrature variations produced in the electric signals passed through the welds are measured and compared against the reference signatures in order to qualitatively evaluate the integrity of the weld.
Official Gazette of the U.S. Patent Office

**N72-21465*** Hazleton Labs., Falls Church, Va.
**FIREFLY PUMP-METERING SYSTEM Patent**
Chris J. Plakas, inventor (to NASA) Issued 26 Oct. 1971 6 p Filed 27 Feb. 1970 Supersedes N70-26801 (08 - 13, p 2390) Sponsored by NASA
(NASA-Case-GSC-10218-1; US-Patent-3,615,241; US-Patent-Appl-SN-15022; US-Patent-Class-23-259; US-Patent-Class-23-253R; US-Patent-Class-73-425.6; US-Patent-Class-141-23; US-Patent-Class-195-127; US-Patent-Class-222-71; US-Patent-Class-222-135; US-Patent-Class-222-309) Avail: US Patent Office CSCL 13K

A pumping and metering dual piston system is described for simultaneously injecting controlled amounts of sample and reactants into a reaction chamber and an enzyme into an adjacent injection chamber. A rotary shaft is actuated to connect the injection chamber with the reaction chamber and to actuate a mechanism for forcing the enzyme from the injection chamber to the reaction chamber. Additionally, the shaft supports and operatively rotates detector apparatus from a magnetic and light radiation-shielded position to a position for monitoring the reaction chamber constituents.
Official Gazette of the U.S. Patent Office

**N72-21466*** Unified Science Associates, Inc., Pasadena, Calif.
**METHOD OF PRODUCING CRYSTALLINE MATERIALS Patent**
Sam Naiditch, inventor (to NASA) Issued 26 Oct. 1971 6 p Filed 3 Sep. 1968 Sponsored by NASA
(NASA-Case-NPO-10440; US-Patent-3,616,338; US-Patent-Appl-SN-756834; US-Patent-Class-204-130; US-Patent-Class-204-59) Avail: US Patent Office CSCL 13H

A method for the electrodeposition of metal crystals from a dense gaseous electrolyte is discussed. A salt of the material to be deposited is dissolved in a suitable solvent and the temperature of the solution raised to at least its critical temperature prior to electrolysis. Official Gazette of the U.S. Patent Office

**N72-21467*#** North American Rockwell Corp., Seal Beach, Calif. Space Div.
**SATURN S-2 QUALITY ASSURANCE TECHNIQUES, NONDESTRUCTIVE TESTING PROCESSES. VOLUME 2: RADIOGRAPHIC REFERENCES**
H. H. Eller and F. E. Sugg 30 Oct. 1970 20 p
(Contract NAS7-200)
(NASA-CR-123488; SD-70-556-2-Vol-2) Avail: NTIS CSCL 14D

Examples of typical radiographic indications that a radiographic film interpreter might encounter during the evaluation of aluminum alloy welds are presented. Most of the examples are of weld discontinuities, although examples of indications caused by extraneous sources are also included. Examples have been photographically reproduced from actual weld radiographs exposed during fabrication of the Saturn S-2. Author

**N72-21468*#** North American Rockwell Corp., Seal Beach, Calif. Space Div.
**SATURN S-2 QUALITY ASSURANCE TECHNIQUES, CRITICAL PROCESS CONTROL. VOLUME 7: METALLIC MATERIALS**
W. D. Ross, Jr. 30 Oct. 1970 117 p
(Contract NAS7-200)
(NASA-CR-123487; SD-70-557-7-Vol-7) Avail: NTIS CSCL 14D

The special skills developed during the Saturn S-2 Program are documented to enable qualified personnel to carry out efficient operations in future S-2 production. Skills covered include: acceptance testing of fusion-welding equipment, weld operators and inspector certification, machine certification, preweld operations, and repair weld certification. F.O.S.

**N72-21469*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**COMPARISON OF CONVENTIONAL AND MICROASPERITY ELASTOHYDRODYNAMIC LUBRICATION OF A BALL SPINNING IN A NONCONFORMING GROOVE**
Charles W. Allen (Chico State Coll., Calif.), Dennis P. Townsend, and Erwin V. Zaretsky Washington Apr. 1972 28 p refs
(NASA-TN-D-6761; E-6713) Avail: NTIS CSCL 11H

An analysis was developed for the microasperity elastohydrodynamic lubrication of a ball spinning in a nonconforming groove. This analysis was compared to the conventional elastohydrodynamic analysis of a ball spinning in a nonconforming groove. Rheological models for a di-2-ethylhexyl sebacate, a super-refined naphthenic mineral oil, and a polyphenyl ether (5P4E) were constructed from spinning torque data by using both analyses. The value of the lubricant pressure-viscosity coefficient that makes the data fit the analyses of the fluids differs somewhat from published data. For all three lubricants, an exponential composite model best described the lubricant rheology. Good agreement existed with the experimental and analytical values of torque for both the conventional and microasperity elastohydrodynamic analysis for a spinning ball in a nonconforming groove. P.N.F.

**N72-21470*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**ARCHED-OUTER-RACE BALL-BEARING ANALYSIS CONSIDERING CENTRIFUGAL FORCES**
Bernard J. Hamrock and William J. Anderson Washington Apr. 1972 35 p refs
(NASA-TN-D-6765; E-6767) Avail: NTIS CSCL 13I

A first-order thrust load analysis that considers centrifugal forces but which neglects gyroscopics, elastohydrodynamics, and thermal effects was performed. The analysis was applied to a 150-mm-bore angular-contact ball bearing. Fatigue life, contact loads, and contact angles are shown for conventional and arched bearings. The results indicate that an arched bearing is highly desirable for high-speed applications. In particular, at an applied load of 4448 n (1000 lb) and a DN value of 3 million (20,000 rpm) the arched bearing shows an improvement in life of 306 percent over that of a conventional bearing. Author

**N72-21471*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**PRESSURE-TIGHT SEAL FOR SUPER ALLOY Patent Application**
Robert E. Little, inventor (to NASA) Filed 12 Jan. 1972 12 p
(NASA-Case-LAR-10170-1; US-Patent-Appl-SN-217213) Avail: NTIS CSCL 11A

A method that provides a pressure tight seal for abutting edge joints in hypersonic aircraft fuel tanks is described. The seal is formed by flame spraying a powdered super alloy, usually 4.5% aluminum and 95.5% nickel, on the tank surface. E.H.W.

**N72-21472*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**DEPLOYABLE PRESSURIZED CELL STRUCTURE FOR A MICROMETEOROID DETECTOR Patent Application**
William H. Kinard, inventor (to NASA) Filed 28 Jan. 1972 10 p
(NASA-Case-LAR-10295-1; US-Patent-Appl-SN-221685) Avail: NTIS CSCL 13H

The invention relates to a micrometeoroid penetration detector having a number of deployable pressurized cell structures

which are caused to leak in response to micrometeoroid penetration. The consequent drop in internal pressure of the cell causes a pressure monitor switch to be closed, providing an indication of the penetration. The cell structure may be deflated and rolled for compact storage at launch and automatically deployed in a substantially planular condition after reaching the desired orbit and trajectory. NASA

**N72-21473*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**JOURNAL BEARINGS Patent Application**
Fredrick T. Schuller and Warren A. Moore, inventors (to NASA) Filed 27 Mar. 1972 16 p
(NASA-Case-LEW-11076-1; US-Patent-Appl-SN-238264) Avail: NTIS CSCL 13I

A number of bearing sectors are mounted in a housing. Each sector functions as a lobed area in the bearing to obtain the required lubricant film geometry. NASA

**N72-21474*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**COMPACT HYDROGENATOR Patent Application**
Peter G. Simmonds, inventor (to NASA) Filed 7 Oct. 1971 22 p
(Contract NAS7-100)
(NASA-Case-NPO-11682; US-Patent-Appl-SN-187365) Avail: NTIS CSCL 13I

Hydrogenation is effected rapidly and conveniently in a hydrogenation unit including a reaction chamber formed of a hydrogen-permeable palladium alloy. A sample of material to be hydrogenated is placed within the reaction chamber and hydrogen is controllably diffused through the walls of the reactor in contact with the sample, at a rate controlled by the pressure differential across the wall of the chamber and/or by the temperature of the wall of the chamber. NASA

**N72-21475*#** Hughes Aircraft Co., Culver City, Calif.
**IMPROVED INJECTOR FOR USE IN HIGH VOLTAGE ISOLATORS FOR LIQUID FEED LINES Patent Application**
John A. Snyder, inventor (to NASA) Filed 7 Oct. 1971 10 p Prepared for JPL
(Contracts NAS7-100; JPL-952131)
(NASA-Case-NPO-11377; US-Patent-Appl-SN-187262) Avail: NTIS CSCL 13I

An injector is described for use in introducing fluid substances into feed lines employed in delivering flowing bodies of liquids. The injector includes a porous plug, concentrically related to a feed line, including an internally tapered surface of a truncated conical configuration. This has an inlet orifice of a first diameter and a discharge orifice, of a second diameter substantially smaller than the first and an external surface circumscribed by an annular chamber containing a body of insulating gas. NASA

**N72-21476*#** North American Rockwell Corp., Downey, Calif.
**APPARATUS FOR REMOTE HANDLING OF MATERIALS Patent Application**
Robert B. Kimball, David T. Hodder, and Walter W. Wrinkle, inventors (to NASA) Filed 30 Dec. 1971 20 p Sponsored by NASA
(NASA-Case-LAR-10634-1; US-Patent-Appl-SN-214084) Avail: NTIS CSCL 13I

A remote handling device for mixing and testing dangerous chemical materials is described. The device is housed in a 30 inch cylindrical test chamber that is divided into two sections. One section, the upper portion, rotates on its horizontal and cylindrical axes and is used to mix the material. A second section, positioned below the first, is used to receive and test the mixed material. NASA

**N72-21477*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**LYOPHILIZED SPORE DISPENSER Patent Application**
Artie D. Jessup, inventor (to NASA) Filed 13 Oct. 1971 9 p
(NASA-Case-LAR-10544-1; US-Patent-Appl-SN-198928) Avail: NTIS CSCL 13I

A lyophilized spore dispenser is described which produces a finely divided, monoparticulate cloud of bacterial spores. The spores are contained within a tightly sealed chamber and a turbulator orifice connected to an air supply source provides a jet of air which stirs up the spores and causes then to be suspended in eddy currents within the chamber. This air jet also produces a positive pressure within the chamber which forces the spores out of an injection orifice. NASA

**N72-21478*#** Aeroflex Labs., Inc., Plainview, N.Y.
**ROTARY ACTUATOR Patent Application**
Charles Kallins and Jerome Ostroff, inventors (to NASA) Filed 4 Jun. 1970 15 p Prepared for JPL
(Contracts NAS7-100; JPL-950897)
(NASA-Case-NPO-10244; US-Patent-Appl-SN-43327) Avail: NTIS CSCL 13I

A rotary actuator suited for use in environments where rolling and sliding friction is to be avoided, such as in a high vacuum celestial space environment, is described. The actuator is characterized by the utilization of a plurality of spaced tri-flex pivots each having a linear torque-angle characteristic over its operative range and an electrically energizable torquer having linear torque-current characteristics over its operating range magnetically coupled with the shaft for imposing rotation for the shaft against the bias of the tri-flex pivots. Also included is an ammeter electrically coupled with the torquer for providing an output indicative of the current being supplied to the torquer and therefore the angular position of the shaft. NASA

**N72-21479*#** General Electric Co., Cincinnati, Ohio.
**FABRICATION AND TEST OF A SPACE POWER BOILER FEED ELECTROMAGNETIC PUMP. PART 1: DESIGN AND MANUFACTURE OF PUMP**
J. W. Gahan, A. H. Powell, P. T. Pileggi, and S. P. Thompson Washington NASA Apr. 1972 229 p refs
(Contract NAS3-9422)
(NASA-CR-1949; GESP-459-Pt-1) Avail: NTIS CSCL 13I

A three-phase helical induction electromagnetic (EM) pump has been designed and built. This pump was designed for use as the boiler-feed pump of a potassium Rankine-cycle space electric power system. The pump is constructed of high temperature materials including a T-111 duct, Hiperco 27 magnetic material, nickel clad silver conductor wire, and a completely inorganic insulation system. The pump is designed to deliver 3.25 lb/sec potassium at 1000 F with a developed head of 240 psi while being cooled by 800 F NaK. At these conditions, the overall pump efficiency is expected to be 18%. Author

**N72-21480*#** National Aeronautics and Space Administration, Washington, D.C.
**SEALS AND SEALING TECHNIQUES**
1972 30 p Prepared in cooperation with Small Business Admin.
(NASA-SP-5905(03)) Avail: NTIS HC $1.00/MF $0.95 CSCL 11A

Developments by the aerospace industry in seals and sealing techniques are announced for possible use in other areas. The announcements presented are grouped as: sealing techniques for cryogenic fluids, high pressure applications, and modification for improved performance. F.O.S.

**N72-21481*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**PROCESS AND APPARATUS FOR MAKING DIAMONDS Patent Application**
John R. Rasquin and Marvin F. Estes, Inventors (to NASA) Filed 21 Apr. 1971 12 p
(NASA-Case-MFS-20698-2; US-Patent-Appl-SN-136086) Avail: NTIS CSCL 13H

A simple device and process, utilizing shock waves, for making industrial diamonds are presented. The device is composed of an exponential horn tapering from a large end to a small end, a copper plate mounted against the large end of the horn, a magnetic hammer adjacent the plate, and an anvil with a small pocket at the small end of the horn which holds the graphite material. The magnetic hammer and copper plate, together create a shock wave in the large end of the horn. The wave velocity is amplified by the horn shape so that all of the wave energy arrives simultaneously at the small end of the horn. This energy is transferred to the graphite material in the anvil pocket creating the pressure and temperature levels necessary to transform the graphite to a diamond. E.H.W.

**N72-21482*#** Spaco, Inc., Huntsville, Ala.
**ULTRASONIC SCANNING SYSTEM FOR IN PLACE INSPECTION OF BRAZED TUBE JOINTS Patent Application**
Johnny L. Haynes, Charles G. Wages, and Hamilton H. Haralson, inventors (to NASA) Filed 9 Nov. 1971 12 p
(Contract NAS8-20081)
(NASA-Case-MFS-20767; US-Patent-Appl-SN-196898) Avail: NTIS CSCL 14D

A miniaturized ultrasonic scanning system for nondestructive, in-place, nonimmersion testing of brazed joints in stainless steel tubing is described. The system is capable of scanning brazed tube joints, with limited clearance access, in 1/4 through 5/8 inch union, tee, elbow, and cross configurations. The system can detect defective conditions not associated with material density changes in addition to those which are dependent upon density variations. The system includes a miniaturized scanning head assembly that fits around a tube joint and rotates transducer around and down a joint in a continuous spiral motion. The transducer is a 3 inch diameter focused beam type with a liquid filled rubber tip or boot attached, which provides a simulated immersion test. The scanning head incorporates suitable mechanical drive features, limit switches to control scan travel, and a transmitter to synchronize a facsimile C-scan recorder with the scanning movement. Designed to track the continuous spiral scan of the tube joint. The scanner and recorder can be operated with most commercially available flaw detectors. The novelty of the invention is in the provision of a device which can scan a tube joint in a circular direction, requires only limited clearance access, and can operate on brazed stainless steel joints. NASA

**N72-21483*#** Bendix Corp., Davenport, Iowa.
**DUAL STAGE CHECK VALVE Patent Application**
David E. Whitten, inventor (to NASA) Filed 10 Dec. 1971 9 p
(Contract NAS9-7689)
(NASA-Case-MSC-13587; US-Patent-Appl-SN-206698) Avail: NTIS CSCL 13K

A dual check valve, designed to prevent leakage in the cryogenic supply system of space flight environmental control systems, is described. The valve is composed of a primary sealing point located between a fixed orifice seat and valve point, and a secondary sealing point between an orifice poppet and a valve poppet. Upstream of the valve orifice is a flexible, convoluted metal diaphragm attached to the orifice poppet. Downstream of the valve orifice, a finger spring exerts a force against the valve poppet, tending to keep the valve in a closed position. The series arrangement of a double seat and poppet is able to tolerate small particle contamination while minimizing chatter by controlling throttling or metering across the secondary seat, thus preserving the primary sealing surface. NASA

**N72-21484*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**APPARATUS AND METHOD OF MOLDING Patent Application**
Wilbur C. Heier, inventor (to NASA) Filed 15 Nov. 1971 15 p
(NASA-Case-LAR-10489-1; US-Patent-Appl-SN-198743) Avail: NTIS CSCL 13H

An apparatus and method are described for compression molding of thermosetting plastic compositions. Heat is applied to the compressed load in a mold cavity and adjusted to hold molding temperature at the interface of the cavity surface and the compressed compound to produce a thermal front. This thermal front advances into the evacuated compound at mean right angles to the compression load and toward a thermal fence formed at the opposite surface of the compressed compound. NASA

**N72-21485*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**METHOD OF FORMING SUPERALLOYS Patent Application**
John C. Freche, William J. Waters, and Richard L. Ashbrook, inventors (to NASA) Filed 10 Mar. 1972 11 p
(NASA-Case-LEW-10805-2; US-Patent-Appl-SN-233743) Avail: NTIS CSCL 13H

A highly alloyed superalloy material is obtained using prealloyed powders. The material is easily shaped at high temperatures, when it becomes superplastic, because of its microstructure. NASA

**N72-21486*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**LAMINATION METHOD AND APPARATUS Patent Application**
Wilbur C. Heier, inventor (to NASA) Filed 20 Jan. 1972 15 p
(NASA-Case-XLA-11028; US-Patent-Appl-SN-219435) Avail: NTIS CSCL 13H

A method is described for preparing laminates of stressed face sandwich structures with light weight cores. The laminate is prepared by providing a lightweight core material, such as a honeycombed plastic, metal, or the like, within the cavity defined by an annular mold cavity frame. Face sheets, which are to be bonded to the core material, are provided on opposite sides of the frame and extend over the frame thus sealing the core material in the cavity. An adhesive is provided between the core material and the face sheets and the combined thickness of the core material and adhesive is a close fit within the opposed face sheets. A gas tight seal, such as an O-ring gasket, is provided between the frame and the face sheet members to form a gas tight cavity between the face sheet members and the frame. External heat and pressure are used to bond the face sheets to the core material. Gas pressure is introduced into the sealed cavity to minimize out-gasing of the adhesive. NASA

**N72-21487*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**EVACUATED DISPLACEMENT COMPRESSION MOLDING Patent Application**
Wilbur C. Heier, inventor (to NASA) Filed 11 Nov. 1971 17 p
(NASA-Case-LAR-10782-1; US-Patent-Appl-SN-197689) Avail: NTIS CSCL 13H

A process is described for molding long thin-wall tubular bodies from thermosetting plastic molding compounds when the tubular body lengths may be several times the diameters. The process is accomplished by loading a predetermined quantity of molding compound into a female mold cavity closed at one end by a force mandrel. After closing the other end of the mold, vacuum is applied along with high temperatures and pressures. The process lasts from 30-60 minutes, after which the force mandrel is force-cooled to effect its thermal shrinkage for easy removal of the tubular article. The balance mandrel is used to push the molded article from the female mold. A mold insert may be attached to the female mold to permit molding of exterior spiral threads on one end of the molded article. NASA

**N72-21488*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**ZERO GRAVITY LIQUID MIXER Patent Application**
Franklin W. Booth and Robert A. Bruce, inventors (to NASA) Filed 24 Nov. 1971 13 p
(NASA-Case-LAR-10195-1; US-Patent-Appl-SN-201782) Avail:

NTIS CSCL 13I

A device, capable of throughly mixing liquids under zero gravity conditions in a short period of time, is described. The device is composed of a closed reservoir that maintains a positive pressure for the liquids, a valved liquid supply line, and a pump for maintaining fluid flow. E.H.W.

**N72-21489*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**LATHE TOOL BIT AND HOLDER FOR MACHINING FIBERGLASS MATERIALS Patent Application**

LaVern E. Winn, inventor (to NASA) Filed 20 Jan. 1972 8 p (NASA-Case-XLA-10470; US-Patent-Appl-SN-219436) Avail: NTIS CSCL 13I

A lathe tool and holder combination for machining resin impregnated fiberglass cloth laminates is described. The tool holder and tool bit combination is designed to accommodate a conventional carbide-tipped, round shank router bit as the cutting medium, and provides an infinite number of cutting angles in order to produce a true and smooth surface in the fiberglass material workpiece with every pass of the tool bit. The technique utilizes damaged router bits which ordinarily would be discarded. NASA

**N72-21490#** Hanford Engineering Development Lab., Richland, Wash.

**PREPARATION, CHARACTERIZATION, AND TESTING OF AUSTENITIC STAINLESS STEEL WELDMENTS**

A. L. Ward, J. E. Irwin, L. D. Blackburn, G. M. Slaughter (ORNL), G. M. Goodwin (ORNL), and N. C. Cole (ORNL) Aug. 1971 81 p refs

(Contract AT(45-1)-2170)

(HEDL-TME-71-118) Avail: NTIS

Weldments were prepared from one-inch thick Type 304 stainless steel plate using the submerged arc, gas metal arc, gas tungsten arc, and shielded metal arc processes. The weldments were prepared at two different laboratories using different filler materials but nearly identical joint design. The results of the tensile tests performed at temperatures between 600 and 900 F indicated a significant difference between the properties of the weld metal and the base metal. Weld metal was much less ductile and had a higher yield strength. Creep rupture tests at 1000 and 1100 F showed that, depending upon the specific weld process and filler metal combinations, the creep properties of weld deposited metal can be very similar or different from those of the parent metal. Author (NSA)

**N72-21491#** Iowa Univ., Iowa City. Dept. of Chemistry.

**A CORONA STUDY RELEVANT TO ELECTROSTATIC PRINTING PROCESS Final Technical Report**

C. W. Frank, J. K. Stille, E. E. Green, and G. B. Dreher Nov. 1971 79 p refs

(Contract DAAK02-71-C-0027; DA Proj. 4A6-62707-A-852)

(AD-735369; ETL-CR-71-22) Avail: NTIS CSCL 07/3

An electrostatic printing method is used to make multicolor reproductions of topographic maps. An area of interest of the process is the possible action of the double corona charging units in the machine on the chemistry of the materials that pass through the corona discharges during the printing sequence. The study will show what effects are observable on representative examples of the dye sensitizer, toner, binder, dispersant, and electrophotographic paper used in the process when these materials are exposed under assimilated printer conditions. Four compounds were observed under conditions which simulated the corona unit. It was found that the only compound formed via the discharge was that of ozone (O3). Phthalocyanine blue, Isopar G, Fluorescein, and an alkyd resin were subjected to ozone concentrations. Other studies including paper charging rates as a function of atmosphere, toner, sedimentation rates, and the effect of ozone on the electrophotographic paper have been carried out. Author (GRA)

**N72-21492#** Army Foreign Science and Technology Center, Charlottesville, Va.

**CONTAINER TRANSPORTATION**

M. D. Sitnij, V. A. Katolichenko, and M. F. Trikhunkov Oct. 1971 244 p Transl. into ENGLISH from the book "Tranport" USSR, 1970 p 1-200

(AD-735436; FSTC-HT-23-1173-71) Avail: NTIS CSCL 13/4

The book gives the technical-economic and operational characteristics of container types and other technical facilities used for container shipments in the various types of transport; deals with the questions of the rational distribution of container points and the organization of container flow, the application of mathematics and electronic computers to the planning and organizing of container transportation, and so on. Author (GRA)

**N72-21493#** National Research Corp., Cambridge, Mass.

**STATIC STRENGTH OF FILM REINFORCED MECHANICAL JOINTS IN FIBROUS COMPOSITES Final Technical Report, 8 Aug. 1969 - 20 May 1971**

Gabriel E. Padawer Jun. 1971 99 p refs

(Contract N00156-70-C-1100)

(AD-735953; NRC-TR-71-500) Avail: NTIS CSCL 13/5

Uniaxial (all 0 deg), bi-axial (+ or - 45 deg), and tri-axial (0 deg, + or - 45 deg) graphite fiber-epoxy resin composites were fabricated to form a series of double lap bolted joint models. These were tested to measure the joint strength effectiveness of plane-isotropic boron film co-laminated locally at six and twelve volume percent levels. The results showed that the addition of omni-directional film plies to the highly directional fiber laminae increased the joint strength and stiffness up to 200 percent, the chief contribution of the boron film being high bearing strength and resistance to shear distortion. A novel test method for bolted lap joints was developed in which the bolt head pressure was maintained constant by means of preloaded springs, thus eliminating the ambiguity resulting from an unknown contribution of the bolt clamping friction to the total joint strength. The measured strength/weight index was 2.45, compared to 0.73 and 0.41 for stainless steel and titanium shims, respectively. Author (GRA)

**N72-21494#** Marquardt Corp., Van Nuys, Calif.

**ADVANCED ACS VALVE SEALING SURFACE COMPATIBILITY INVESTIGATION Final Report, 15 May 1970 - 15 Jul. 1971**

Gerald R. Pfeifer, Horst Wichmann, and Reinholdt Kratzer Sep. 1971 208 p refs

(Contract F04611-70-C-0052; AF Proj. 3058)

(AD-735286; MR-S-1017; AFRPL-TR-71-84) Avail: NTIS CSCL 13/11

A research program was necessitated by the finding that a developed magnetically linked bipropellant valve showed extensive finish deterioration of both the poppet and seat mating surfaces after being operated in chlorine pentafluoride (CPF). The same valve design, using the same materials of construction, performed properly when operated using liquid monomethyl hydrazine. Surface roughness measurements on CPF exposed poppets furthermore revealed that the surface finish deterioration was far more severe in sealing and impact areas than on nonsealing surfaces. The prime objective, that of determining the mechanism of sealing surface deterioration, was accomplished during the program. In addition, design parameters were evolved which can lead to a successful design meeting all of the design objectives for valve operational performance in fluorinated oxidizers. Author (GRA)

**N72-21495#** Army Foreign Science and Technology Center, Charlottesville, Va.

**ACOUSTIC JET CONTROL SYSTEMS**

V. G. Gradetskii and V. N. Dmitriyev Oct. 1971 16 p refs Transl. into ENGLISH from Mashinovedenie (USSR), no. 5, Sep.-Oct. 1969 p 31-39

(AD-735234; FSTC-HT-23-677-71; OACSI-J-9802) Avail: NTIS CSCL 13/7

With respect to functional design, the pneumatic servomechanism control systems can be programmed or they can receive signals to execute certain operations from terminal switches. A trend increasing speed and decreasing operating pressures is being observed in pneumoautomation. In this article a study is made of a multichannel pneumoacoustic control system for an open drive. GRA

N72-21496# Sperry Rand Corp., Troy, Mich. Aerospace Div.
**DEVELOPMENT OF A VARIABLE DELIVERY POSITIVE DISPLACEMENT FUEL PUMP Final Report, 6 Jan. 1969 - 4 Mar. 1971**
N. F. Pederson Wright-Patterson AFB, Ohio AFAPL Sep. 1971 83 p
(Contract F33615-69-C-1288; AF Proj. 3066)
(AD-735259; AFAPL-TR-71-71) Avail: NTIS CSCL 13/11

A Research and Development Program was conducted to produce a variable, positive displacement pump for application to the fuel systems of turbine engines. A variable positive displacement pump complete with an electrical input signal actuation system was designed and developed to physically fit and supply the flow requirements of the J-85-7 turboject engine. Author (GRA)

N72-21497# Air Force Systems Command, Wright-Patterson AFB, Ohio.
**MULTIMEGAJOULE, PULSING, EXPLOSIVE DRIVEN MHD FEASIBILITY STUDY**
Ronald Pape Nov. 1971 74 p refs
(AF Proj. 3145)
(AD-735660; AFAPL-TR-71-11) Avail: NTIS CSCL 10/2

The document reports on a preliminary investigation to determine whether explosive driven magnetohydrodynamics (MHD) can be scaled to multimegajoule levels and produce quickly repeating pulses at these high energy levels. In the study, pulse durations below one millisecond are of primary concern. Author (GRA)

N72-21498# Florida Univ., Gainesville. Dept. of Industrial and Systems Engineering.
**THE PRODUCTION RATE OF A SERIES OF WORK STATIONS WITH VARIABLE SERVICE TIMES**
Eginhard J. Muth Nov. 1971 25 p refs
(Contract DAHC04-68-C-0002; DA Proj. 2T0-14501-B-81-B)
(AD-735363; TR-58; AROD-T-1-82-RT) Avail: NTIS CSCL 12/2

A mathematical model for the interdemand time at the first station of a production line with stochastic service times is presented. Production rate is expressed as the reciprocal of mean interdemand time. The analysis is not restricted to the assumption of exponentially distributed service times. General solutions for the distribution of interdemand time are derived for 2 and 3 work stations. For any number of work stations a lower bound on production rate is presented graphically. It is shown that production rates obtained with exponentially distributed service times are unrealistically low. Author (GRA)

N72-21499# Midwest Research Inst., Kansas City, Mo.
**THE MATHEMATICAL ANALYSIS OF FLUID VISCOSITY DATA Technical Report, May - Jul. 1971**
George R. Hampton and Ronald D. Butler Wright-Patterson AFB, Ohio AFAPL Nov. 1971 53 p refs
(Contract F33615-69-C-1265; AF Proj. 3048)
(AD-735270; AFAPL-TR-71-85) Avail: NTIS CSCL 11/8

The report describes a process for analyzing and summarizing fluid viscosity data over extended temperature ranges. Viscosity data for 34 synthetic turbine engine lubricants were obtained over the temperature range 100 to 500 F; for several of the fluids, which are thermally stable, this range was extended to 700 F. Conventional methods are inadequate for handling and describing viscosity data over such extended ranges. It has been found that two empirical relationships correctly predict the variation of fluid viscosity with temperature. A computer program was used to perform least-squares analyses of the data; the treatment yields values for the parameters that give the best fit to the experimental data. Derivations of the least-squares equations are given for the two formulas, together with the computer program and the results of the data analysis. Author (GRA)

N72-21500# Purdue Univ., Lafayette, Ind. Automatic Control Center.
**ADAPTIVE COMPUTER CONTROL OF A GLASS COATING PROCESS**
Robert L. Thomas (Corning Glass Works, N. Y.), Raymond E. Goodson, and Ed. J. Harter (Corning Glass Works, N. Y.) Jan. 1972 18 p refs
(Contract N00014-67-A-0226-0012; NR Proj. 041-423)
(AD-735154; ACC-72-1; TR-2) Avail: NTIS CSCL 13/8

The paper presents the development and implementation of an on-line adaptive controller in an industrial process. The process, drawing and coating of glass rod used in the manufacture of resistors, is described briefly and the control problem formulated. The proposed control system, based on an on-line digital computer system, is outlined. Synthesis of the adaptige controller, including an identification technique and closed loop optimization strategy, is presented. Software development, testing, and implementation of the controller is described; special emphasis is given to on-line programming techniques. Results of the implementation are presented and the development summarized. Author (GRA)

N72-21521# Joint Publications Research Service, Arlington, Va.
**DEVICE FOR OBTAINING MIXTURES OF METAL CHLORIDE VAPORS**
B. S. Lysov and A. N. Tumanov *In its* Nonferrous Met. 9 Mar. 1972 p 19-22 refs (See N72-21517 12-17)
Avail: NTIS

# 16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N72-21501*# Translation Consultants, Ltd., Arlington, Va.
**USE OF A LASER FOR SPECTRAL-ISOTOPIC DETERMINATION OF VOLUMETRIC AND SURFACE CONTENT OF OXYGEN IN METALS**
A. A. Petrov and G. V. Skvortsova Washington NASA Apr. 1972 12 p refs Transl. into ENGLISH from Zh. Prik. Spektroskoppi, Akad. Nauk Belorussk. SSR (Minsk), v. 14, no. 5, May 1971 p 793-800
(Contract NASw-2038)
(NASA-TT-F-14148) Avail: NTIS CSCL 20E

The isotope exchange of C(O-18) and C(O-16)2 O dissolved in the metal was accomplished by melting a small amount of metal by a laser pulse focused on its surface. The amount of exchanged O was determined by standard methods. A laser beam (10,600 A) with a pulse energy up to 300 J was used. Author

N72-21502*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
**ATOMIC HYDROGEN MASER WITH BULB TEMPERATURE CONTROL TO REMOVE WALL SHIFT IN MASER OUTPUT FREQUENCY Patent Application**
Robert F. C. Vessot and Martin W. Levine, inventors (to NASA) Filed 23 Sep. 1971 17 p
(Contract NSR-09-015-098)
(NASA-Case-HQN-10654-1; US-Patent-Appl-SN-182978) Avail: NTIS CSCL 20E

An atomic hydrogen maser is described with automatic control of bulb temperature to eliminate frequency shift due to collision of atomic hydrogen with the storage bulb walls. The storage bulb volume is changed by using a flexible bulb, and the frequency of the maser output is measured for at least two different surface-to-volume configurations. The temperature of the bulb is maintained so that the output frequency is independent of the surface-to-volume ratio of the bulb and hence independent of atomic collision rate. Control is maintained by measuring maser output frequency over each half-cycle for bulb configuration varying between minimum and maximum volume. NASA

**N72-21503*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**AZIMUTH BEARING SYSTEM AND METHOD Patent Application**
Louis Caudill, inventor (to NASA) Filed 14 Jul. 1971 15 p
(NASA-Case-GSC-11262-1; US-Patent-Appl-SN-162380) Avail: NTIS CSCL 20E

The relative azimuth bearing between first and second space terrestrial points (which may be obscured from each other by intervening terrain) is measured by placing at one of the points a laser source for projecting a collimated beam upward in the vertical plane. The collimated laser beam is detected at the second point by positioning the optical axis of a receiving instrument for the laser beam in such a manner that the beam intercepts the optical axis. In response to the optical axis intercepting the beam, the beam is deflected into two different ray paths by a beam splitter having an apex located on the optical axis. The energy in the ray paths is detected by separate photoresponsive elements that drive logic networks. NASA

**N72-21504#** California Univ., Livermore. Lawrence Radiation Lab.
**TENTATIVE METHODS OF TEST FOR THE OPTICAL PROPERTIES OF LASER RODS**
E. D. Baird 25 Oct. 1971 10 p refs Presented at the ASTM Subcomm. 2 Meeting, New Orleans, La., 12 Jan. 1972 Submitted for publication
(UCRL-73478; Conf-720103-1) Avail: NTIS

Test methods are presented for determining the optical properties of crystal laser rods including neodymium-doped glass and ruby. The optical properties include wavefront distortion, surface quality, bubbles and inclusions, striae, strain absorption, and refractive index. Author

**N72-21505#** Naval Undersea Research and Development Center, San Diego, Calif.
**VIBRATIONAL ANALYSIS OF THE FLEXING HEAD OF THE BQS-6 TRANSDUCER Research and Development Report, Jan. - Apr. 1971**
J. T. Hunt, D. Barach, and C. Johnson Nov. 1971 34 p refs
(SF Proj. 11-121-301)
(AD-735459; NUC-TP-239) Avail: NTIS CSCL 17/1

The purpose of the work in this report was to develop a finite-element mathematical model for the equations of motion that are related to the BQS-6 transducer's flexing head. Results showed that holographic interferometry is an extremely sensitive and accurate experimental technique for measuring the small displacements of vibrating systems and that the finite-element method is an excellent tool for theoretically predicting this behavior. The finite-element ansatz predicted all measured resonant frequencies within 5 percent. Predicted mode shapes could not be distinguished from those measured by holographic interferometry. Author (GRA)

**N72-21506#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**NEW POSSIBILITIES FOR THE USE OF SEMICONDUCTOR DIODE LASERS**
Gabor Kiss 19 Oct. 1971 15 p Transl. into ENGLISH from Hiradastech. (Budapest), v. 21, no. 9, 1970 p 275-278
(AD-735463; FTD-HC-23-979-71) Avail: NTIS CSCL 20/5

The possibility of whether a fast operating computer can be made with the use of diode lasers is examined. Starting with the physical bases of the operation of diode lasers, their use in telecommunications engineering is briefly outlined. Finally the use of the couples laser photodiode as fast operating logic circuit elements is discussed. Author (GRA)

**N72-21507#** New Mexico Univ., Albuquerque. Bureau of Engineering Research.
**NEUTRON IRRADIATION EFFECTS ON DIFFUSED GaAs LASER DIODES**
Bruce W. Noel, Charles E. Barnes (Sandia Labs.), and Harold D. Southward Sep. 1971 243 p refs
(Contract N00014-68-A-0158)
(AD-735939; EE-186(71)ONR-005) Avail: NTIS CSCL 20/5

A detailed study has been made of the pre- and post-irradiation electrical and optical properties of diffused GaAs laser diodes. The emphasis of the study was on the current and electroluminescence (EL) mechanisms existing in the diodes below lasing threshold and the effects of fast neutron irradiation on those mechanisms. Changes were observed in the current-voltage characteristics and in the EL spectra at several temperatures between 75 and 300K. The irradiations were performed at low temperature (- 140K) to a fluence of 1.8 x 10 to the 15th power nvt (= 10 keV). Capacitance-voltage measurements were used to monitor the majority-carrier concentrations before and after irradiation. Author (GRA)

**N72-21508#** Aerospace Corp., El Segundo, Calif. Lab. Operations.
**ATMOSPHERIC-TURBULENCE-INDUCED LASER BEAM-SPREAD**
Harold T. Yura 30 Oct. 1971 25 p refs
(Contract F04701-71-C-0172)
(AD-735665; TR-0172(9230-10)-13; SAMSO-TR-71-331) Avail: NTIS CSCL 20/6

The report presents a general simplified prescription for estimation of the beamspread of a laser beam propagating in a turbulent medium. Simple analytic approximations are presented. These permit estimation of beamspread and antenna gain without the detailed numerical calculations associated with an arbitrary wavefront in an aperture. The physical significance of these results is discussed. Finally, recent experimental data for the atmospheric temperature structure constant profile are presented and used for estimation of the turbulence-induced beamspread and mean on-axis power loss of an upwardly propagating, 0.53-micrometer beam. Author (GRA)

**N72-21509#** Naval Ordnance Lab., White Oak, Md.
**A COMPUTER PROGRAM FOR CO2-N2-H2O GASDYNAMIC LASER GAIN AND MAXIMUM AVAILABLE POWER**
Walter J. Glowacki and John D. Anderson, Jr. 30 Oct. 1971 38 p refs
(AD-735878; NOLTR-71-210) Avail: NTIS CSCL 20/5

A Fortran IV computer program is presented for the calculation of small-signal gain and maximum available energy for CO2-N2-H2O gasdynamic lasers. In comparison to an earlier version, the present program contains several computational improvements which result in a dramatic, order-of-magnitude reduction in computation time. These improvements are discussed in detail. Author (GRA)

**N72-21510#** Aerospace Corp., El Segundo, Calif. Engineering Science Operations
**POLYPAGOS USER'S MANUAL Final Report, Aug. 1968 - Oct. 1971**
Ronald V. Larson 15 Oct. 1971 195 p refs
(Contract F04701-71-C-0172; AF Proj. 681D)
(AD-735674; TR-0172(2311)-1; SAMSO-TR-71-322) Avail: NTIS CSCL 20/6

POLYPAGOS, Polychromic Program for the Analysis of

General Optical Systems, uses both geometric and frequency response techniques. Four main tools for measuring optical system performance are provided in the program: (1) calculation of first order parameters and Seidel aberration coefficients, (2) the full field ray trace, (3) the spot diagram, and (4) the two-dimensional polychromatic Optical Transfer Function. Both the full field ray trace and the spot diagram examine geometrical aberrations, while the Optical Transfer Function measures the frequency response of a system subject to geometrical errors and diffraction effects. The program produces plots of the spot diagram, two-dimensional Point Spread Function, and two-dimensional Modulation Transfer Function. Author (GRA)

**N72-21511#** Army Electronics Command, Fort Monmouth, N.J. Beam and Plasma Devices Technical Area.
**POPULATION INVERSION IN A PULSED C O2-N2-He DISCHARGE M.S. Thesis - Monmouth Coll.**
Mortimer H. Zinn Nov. 1971 62 p refs
(DA Proj. 1S6-62705-A-055)
(AD-735334; ECOM-3503) Avail: NTIS CSCL 20/5

Measurements of the gain in an amplifier discharge tube containing a fixed composition, 1:1.5:5.6 CO2-N2-He gas were made under both ac excited and pulse discharge conditions. While the ac gain results indicated a possible increase in gain with increasing current densities, the pulsed discharge experiments failed to bear out this extrapolation. Instead, the gain reaches a limit that is apparently due to the availability of CO2, but persists for 240 to 300 microseconds after the conclusion of the excitation pulse. Population inversion was calculated from the pulsed gain measurements. The results indicate that high-powered laser action cannot be achieved by extension of the linear design used. The results also indicate that experimenters cannot assume the achievement of high-peak-power output based on measured average-power output and the excitation duty cycle.
Author (GRA)

**N72-21512#** Ohio State Univ., Columbus. ElectroScience Lab.
**LASER ABSORPTION IN THE 5 MICRON BAND Quarterly Technical Report, 23 Jun. - 20 Sep. 1971**
Ronald Long Griffiss AFB, N. Y. RADC 11 Nov. 1971 43 p refs
(Contract F30602-72-C-0016; ARPA Order 1279)
(AD-736037; ESL-3271-1; RADC-TR-71-314) Avail: NTIS CSCL 20/5

The report summarizes technical details of the work performed from June 23 to September 23, 1971. A Detailed discussion of work performed at the Ohio State Univ. Electro-Science Laboratory is presented. This work consisted of atmospheric transmittance calculations near 5 micrometers and the design of a laboratory experiment to determine the transmittance of CO laser radiation through synthetic atmospheres. Computer programs have been written to calculate the molecular absoption due to atmospheric absorbers near 5 micrometers. The types of calculations include computer plots of the calculated spectra, more accurate transmittance values at the frequencies of the CO laser emissions for horizontal paths, and transmittance values at the frequencies of the CO laser emissions for slant paths through the atmosphere. Preliminary calculations are presented with water vapor as the only atmospheric absorber considered. The design of an experiment to measure the transmittance of the CO laser emissions through simulated atmospheres is described. Specific topics covered are the CO laser, selection of the emission lines to be measured, the multiple traversal cell, and the experimental procedure. Author (GRA)

**N72-21513#** General Electric Co., Schenectady, N.Y. Research and Development Center.
**OXIDE CERAMIC LASER Semiannual Technical Report, 1 Jun. - 31 Dec. 1971**
Charles D. Greskovich 25 Jan. 1972 19 p
(Contract N00014-70-C-0360; ARPA Order 1587)
(AD-736223; SRD-72-016) Avail: NTIS CSCL 20/5

The long range goal of the current research program is to develop an intermediate gain, solid laser material which has an emission line width between that of neodymium-doped glass and neodymium-doped yttrium aluminum garnet single crystals. Such material should be suitable for generating high average power combined with high peak power. In order to achieve this goal, experimental and theoretical work has been done in the past 18 months to (1) develop a process to reproducibly fabricate Nd-doped Yttralox (TN), a polycrystalline oxide ceramic comprised of 89 mole % Y203, 10% ThO2, and 1% Nd203 in solid solution, of improved optical quality, (2) understand the densification process with respect to the kinetics of porosity change and (3) evaluate Nd-doped Yttralox rods as a potential laser material by means of optical measurements. Author (GRA)

# 17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

**N72-21514** National Lending Library for Science and Technology, Boston Spa (England).
**RESEARCH AT WORKS LABORATORIES AND INSTITUTES. OF I. P. BARDIN CENTRAL RESEARCH INSTITUTE FOR FERROUS METALLURGY.**
M. A. Artsishevskii, A. I. Zusman, E. A. Sizov, A. A. Brodov, A. P. Koltsova, A. N. Emelyanov, S. A. Chertov, and Yu. I. Krdmzaev [1971] 5 p Transl. into ENGLISH from Stal (Moscow), v. 10, 1971 p 946
(NLL-M-21286-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The thermal stability of twisted cores of molybdenum alloy was studied over a range of climatic temperatures between -60 and +120 C. The economic effectiveness of producing and using low-alloy steels is considered. An economic assessment is presented for different methods of raising the yield of sound metal in the production of cast and rolled blooms and slabs.
K.P.D.

**N72-21515** National Lending Library for Science and Technology, Boston Spa (England).
**SUPERPLASTICITY: ARE WE TO EXPECT A REVOLUTION IN METALLURGY?**
H. Checinska Jan. 1972 12 p refs Transl. into ENGLISH from Postepy Fiz. (Poland), v. 21, no. 5, 1970 p 651-658
(NLL-RTS-6944) Avail: Natl. Lending Library, Boston Spa Engl.: £1.10, 4 NLL photocopy coupons

Superplastic alloys and metals and their distinguishing characteristics are considered. Two kinds of superplasticity are recognized: the transformation type, occurring principally in metals with various allotropic modifications, and the isothermal type, which does not require temperature cycling to occur. The conditions under which superplasticity occurs are discussed, as well as methods for producing superplastic materials. Superplastic flow and superplastic creep in metals and alloys are also considered.
K.P.D.

**N72-21516** National Lending Library for Science and Technology, Boston Spa (England).
**DETERMINATION OF STRUCTURAL CHANGES DURING ANNEALING OF STRAIN HARDENED, (WORK HARDENED) METALS**
N. V. Dubovitskaya and L. N. Larikov Jan. 1972 29 p refs Transl. into ENGLISH from Metallofizika, (USSR), v. 29, 1970 p 30-43
(NLL-RTS-6799) Avail: Natl. Lending Library, Boston Spa Engl.: £2.80; 9 NLL photocopy coupons

Different methods are considered for the determination of

the types of structural elements which occur during the process of annealing of heavily deformed (worked) metals. The initial assumptions made for a similar analysis during the study of well-annealed metals were used as criteria, together with criteria resulting from the processes of polygonization and recrystallization. Author

**N72-21517#** Joint Publications Research Service, Arlington, Va.
**NONFERROUS METALLURGY**
9 Mar. 1972 40 p refs Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedeniy, Tsvetnaya Metallurgiya (USSR), No. 5, 1971
(JPRS-55392) Avail: NTIS

Thermodynamic and solid solution of studies of nonferrous metallic compounds are presented. The compounds investigated include titanium and chromium borides, zirconium dioxide, chromium-titanium alloys, niobium and niobium nitrides, and various metallic chlorides. For individual titles, see N72-21518 through N72-21524.

**N72-21518#** Joint Publications Research Service, Arlington, Va.
**STUDY OF CONDITIONS OF WETTING TITANIUM AND CHROMIUM BORIDES BY IRON GROUP METALS**
S. S. Kiparisov, Yu. K. Kuzmina, and G. A. Libenson *In its* Nonferrous Met. 9 Mar. 1972 p 1-6 refs (See N72-21517 12-17)
Avail: NTIS

The methods of metallography and X-ray phase analysis were used to establish the interaction between chromium and titanium borides, and iron and nickel. The values of marginal wetting angles of CrB, CrB2, TiB, and TiB2 with liquid nickel, iron, and iron-nickel alloy were determined as functions of temperature, heating time, and carbon and boron content. It was determined that with an increase in holding time, the wetting angles decreased, since wetting is due to the phase formed during interaction of solid boride substrate with the liquid metal. A study was made of sintering conditions for titanium boride with additions of 2, 6, and 10% by weight of Ni and also of 3% Ni + 3% Fe. The possibility of making low porosity cermet materials based on titanium boride is suggested. Author

**N72-21519#** Joint Publications Research Service, Arlington, Va.
**VAPOR PRESSURE AND THERMODYNAMIC FUNCTIONS OF MAGENSIUM CHLORIDE AND POTASSIUM CHLORIDE IN THE TITANIUM SPONGE (GRAPHITE)-CHLORIDE SYSTEM** c18
V. L. Kurbatov and E. Ye. Lukashenko *In its* Nonferrous Met. 9 Mar. 1972 p 7-13 refs (See N72-21517 12-17)
Avail: NTIS

The thermodynamics of system composed of a capillary porous body and a liquid was studied in detail using carbon (graphite, silica gel) and water. A study was also made of the thermodynamic properties of magnesium and potassium chlorides individually in the systems graphite-chloride and titanium sponge-chloride. K.P.D.

**N72-21520#** Joint Publications Research Service, Arlington, Va.
**CHARACTERISTIC FEATURES OF INTERACTION OF ZIRCONIUM DIOXIDE WITH CARBON AT HIGH TEMPERATURES** c18
Yu. A. Pavlov, A. V. Manukhin, and V. F. Melekhin *In its* Nonferrous Met. 9 Mar. 1972 p14-18 refs (See N72-21517 12-17)
Avail: NTIS

Experiments were performed in the study of ZrO2 interactions with graphite powder whose particles were about the size of 1 mm. It was determined that the size of the reducing agent particles affects the limiting stage of the interaction process of ZrO2 with carbon. K.P.D.

**N72-21521#** Joint Publications Research Service, Arlington, Va.
**DEVICE FOR OBTAINING MIXTURES OF METAL CHLORIDE VAPORS** c15
B. S. Lysov and A. N. Tumanov *In its* Nonferrous Met. 9 Mar. 1972 p 19-22 refs (See N72-21517 12-17)
Avail: NTIS

A device is described which involves the separate evaporation of halides and mixing their vapors before input to the reaction zone. The calibration of the apparatus is also discussed. K.P.D.

**N72-21522#** Joint Publications Research Service, Arlington, Va.
**STUDY OF THE STRUCTURE AND TEMPERATURE OF THE BRITTLE-DUCTILE TRANSITION OF SOME ALLOYS OF THE Cr-Ti-V-B SYSTEM**
V. S. Zolotorevskiy, S. V. Indenbaum, G. V. Karsanov, and T. P. Khazanova *In its* Nonferrous Met. 9 Mar. 1972 p 23-28 refs (See N72-21517 12-17)
Avail: NTIS

A study was made of the effect of titanium concentration on the structure and temperature of the brittle-ductile transition in hot extruded bars of alloys of the Cr-Ti-V-B system in the initial and heat-treated states. The titanium concentration varied from 0.25 to 1.5%, and vanadium and boron content were constant at 1.5 and 0.05%, respectively. The results of measuring the temperature of the brittle-ductile transition of the alloys are presented. The presence in the alloy samples of a two-phase surface layer with uniform particle distribution of the excess phase is weakly expressed in the magnitude of transition temperature for bending tests. In alloys with an increased titanium content, the increase in transition temperature after heating was not accompanied by visible changes in structure. Reduction in transition temperature after heating alloys with low titanium content was connected primarily with a decrease in density of old blocked dislocations, thus possibly facilitating plastic flow. K.P.D.

**N72-21523#** Joint Publications Research Service, Arlington, Va.
**SOLUBILITY OF CARBON IN NIOBIUM** c18
I. I. Druzhinin, A. M. Zakharov, and I. I. Novikov *In its* Nonferrous Met. 9 Mar. 1972 p 29-35 refs (See N72-21517 12-17)
Avail: NTIS

Alloys containing up to 1.85% by weight of C were prepared in an arc furnace with a tungsten electrode on a copper water-cooled sole, in an atmosphere of purified helium. The temperature of initial melting of the alloys was determined with an accuracy of + or - 20 degrees by the method of first drop appearange, using an optical pyrometer calibrated by the melting points of Zr, Nb, and Mo. Summary data are tabulated for the solubility of carbon in niobium in the solid state. In comparing the structures of the annealed and quenched alloys, a strong dependence was observed of the nature and number of separations of Nb2C on the cooling rate. K.P.D.

**N72-21524#** Joint Publications Research Service, Arlington, Va.
**NEUTRON DIFFRACTION ANALYSIS OF NIOBIUM NITRIDE Nb4N3** c06
A. Yu. Chervyakov, V. A. Somenkov, Ya. S. Umanskiy, S. Sh. Shil'shteyn, and V. P. Yanchur *In its* Nonferrous Met. 9 Mar. 1972 p 36-40 refs (See N72-21517 12-17)
Avail: NTIS

An experiment was performed to define the lattice of Nb4N3 and to study possible variations with increase in temperature, using neutron diffraction. Test samples were obtained by nitriding a thin (100 microns) niobium foil at 1900 + or degrees for 6 hours with a nitrogen pressure of 250 to 500 mm Hg, and annealing (2 hours) to 2050 degrees, followed by rapid cooling. Diffraction patterns were made using a vertical neutron diffractometer with a focusing monochromator of ferrosilicon. In addition to strong lattice reflections, a number of additional peaks were observed, which could be indexed to a cell with parameters a = 4.382 A, c = 8.632 A. The results obtained in

the study show the relation between the degree of order and the shifts of the Nb atoms from the ideal positions in the face sintered cubic lattice. The variation in degree of order with an increase in annealing temperature indicates that the compound Nb4N3 must be considered a superlattice compound arising from the disordered deduction solution based on the MeX lattice (of the NaCl-type). Consequently, with sufficiently high temperature, a phase transition of the order-disorder type must take place. K.P.D.

**N72-21525*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**ALLOY SOFTENING IN BINARY MOLYBDENUM ALLOYS**
Joseph R. Stephens and Walter R. Witzke 1972 33 p refs Proposed for presentation at Spring meeting of the Am. Inst. of Mech. Engr., Boston, 8-11 May 1972
(NASA-TM-X-68028; E-6834) Avail: NTIS CSCL 11F

An investigation was conducted to determine the effects of alloy additions of Hf, Ta, W, Re, Os, Ir, and Pt on the hardness of Mo. Special emphasis was placed on alloy softening in these binary Mo alloys. Results showed that alloy softening was produced by those elements having an excess of s+d electrons compared to Mo, while those elements having an equal number or fewer s+d electrons than Mo failed to produce alloy softening. Alloy softening and hardening can be correlated with the difference in number of s+d electrons of the solute element and Mo. Author

**N72-21526*#** Battelle Memorial Inst., Columbus, Ohio.
**DEVELOPMENT OF OXIDATION RESISTANCE IN THORIATED NICKEL-CHROMIUM BASE ALLOYS Final Report, 3 Dec. 1970 - 30 Nov. 1971**
M. S. Seltzer, B. A. Wilcox, R. I. Jaffee, and J. Stringer (Liverpool Univ.) 31 Dec. 1971 82 p refs
(Contract NAS3-14326)
(NASA-CR-120880) Avail: NTIS CSCL 11F

A pack process was developed which permits the introduction of nearly six weight percent aluminum into solid solution in the near-surface region of TDNiCr (Ni-20Cr-2ThO2. At this aluminum concentration an adherent alumina scale is produced on the alloy surface upon exposure to an environment of 1330 n/sq m (10 torr) or 101,000 n/sq m (760 torr) air at temperatures of 1093 C (2000 F) and 1204 C (2200 F). Room temperature mechanical properties of the aluminized alloys compare favorably with those of TDNiCr as received. While diffusivities for aluminum are a factor of three higher than those for chromium in TDNiCr or Ni-20Cr, the diffusion rates are similar for either of these elements in the thoriated or unthoriated alloy for a given temperature and grain size. Author

**N72-21527*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**STUDY OF A COLUMNAR GRAIN STRUCTURE PRODUCED IN A SUPERALLOY BY GRADIENT-ANNEALING PRE-ALLOYED POWDER EXTRUSIONS**
Robert V. Miner, Jr. Washington Apr. 1972 19 p refs
(NASA-TM-X-2545; E-6793) Avail: NTIS CSCL 11F

Annealing in a temperature gradient was used to produce a structure of continuous columnar grains in alloy 713 C made by extrusion of prealloyed powder. The columnar-grained specimens had tensile strengths within plus or minus 5 percent of those of the as-cast alloy at 760 C and 980 C but were significantly stronger at room temperature. Stress-rupture tests at 760 C and 980 C showed lives scattered from 17 to 376 percent of those of as-cast 713 C tested under the same conditions. X-ray diffraction studies showed the large grains formed upon annealing to have a well-defined texture, although the as-extruded material had none. Author

**N72-21528*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**NONDESTRUCTIVE SPOT TEST METHOD FOR MAGNESIUM AND MAGNESIUM ALLOYS Patent Application**
Maywood L. Wilson, inventor (to NASA) Filed 16 Jul. 1971 11 p
(NASA-Case-LAR-10953-1; US-Patent-Appl-SN-163152) Avail: NTIS CSCL 11F

A method for spot test identification of magnesium and various magnesium alloys commonly used in aerospace applications is described. The spot test identification involves color codes obtained when several drops of 3M hydrochloric acid are placed on the surface to be tested. After approximately thirty seconds, two drops of this reacted acid are transferred to each of two depressions in a spot plate for additions of other chemicals with subsequent color changes indicating magnesium or the alloy. NASA

**N72-21529*#** TRW, Inc., Cleveland, Ohio. Materials Technology Lab.
**INTERACTIONS BETWEEN CREEP, FATIGUE AND STRAIN AGING IN TWO REFRACTORY ALLOYS**
K. D. Sheffler Feb. 1972 48 p refs
(Contract NAS3-6010)
(NASA-CR-120891; TRW-ER-7451; TR-2) Avail: NTIS CSCL 11F

The application of low-amplitude, high-frequency fatigue vibrations during creep testing of two strain-aging refractory alloys (molybdenum-base TZC and tantalum-base T-111) significantly reduced the creep strength of these materials. This strength reduction caused dramatic increases in both the first stage creep strain and the second stage creep rate. The magnitude of the creep rate acceleration varied directly with both frequency and A ratio (ratio of alternating to mean stress), and also varied with temperature, being greatest in the range where the strain-aging phenomenon was most prominent. It was concluded that the creep rate acceleration resulted from a negative strain rate sensitivity which is associated with the strain aging phenomenon in these materials. (A negative rate sensitivity causes flow stress to decrease with increasing strain rate, instead of increasing as in normal materials). By combining two analytical expressions which are normally used to describe creep and strain aging behavior, an expression was developed which correctly described the influence of temperature, frequency, and A ratio on the TZC creep rate acceleration. Author

**N72-21530#** Joint Publications Research Service, Arlington, Va.
**CORROSIVE STABILITY OF METALS AND METAL COATINGS UNDER ATMOSPHERIC CONDITIONS**
G. K. Berukshtis and G. B. Klark 28 Mar. 1972 4 p Transl. into ENGLISH from the book "Korrozionnaya Ustoychivost' Metallov i Metallicheskikh Pokrytiy v Atmosfernykh Usloviyakh" Moscow, 6 Jul. 1971 p 3-4
(JPRS-55554) Avail: NTIS

The forward is presented for a book on atmospheric corrosion of metals. The book discusses the work being done by corrosion institutes in the USSR, and various metallic systems and means of protecting against atmospheric corrosion are considered. K.P.D.

**N72-21531#** Joint Publications Research Service, Arlington, Va.
**STUDYING THE TRUE STRENGTH CHARACTERISTICS OF SEVERAL HEAT-RESISTANT ALLOYS AT HIGH TEMPERATURES**
V. N. Rudenko and A. S. Spivakov 28 Mar. 1972 8 p refs Transl. into ENGLISH from Probl. Prochnosti (Kiev), no. 5, May 1971 p 77-80
(JPRS-55556) Avail: NTIS

The method described allows precise construction of true deformation diagrams of materials in the 20 to 1100 C temperature interval. The results of the studies permit the establishment of dependence between transverse and longitudinal deformations of a specimen at any temperature up to the point of rupture. Author

**N72-21532*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**THERMAL EFFECTS IN EQUILIBRIUM SURFACE SEGREGATION IN A COPPER/10-ATOMIC-PERCENT-ALUMINUM ALLOY USING AUGER ELECTRON SPECTROSCOPY**
John Ferrante Washington Apr. 1972 13 p refs
(NASA-TM-X-2543; E-6766) Avail: NTIS CSCL 11F

Equilibrium surface segregation of aluminum in a copper-10-atomic-percent-aluminum single crystal alloy oriented in the /111/ direction was demonstrated by using Auger electron spectroscopy. This crystal was in the solid solution range of composition. Equilibrium surface segregation was verified by observing that the aluminum surface concentration varied reversibly with temperature in the range 550 to 850 K. These results were curve fitted to an expression for equilibrium grain boundary segregation and gave a retrieval energy of 5780 J/mole (1380 cal/mole) and a maximum frozen-in surface coverage three times the bulk layer concentration. Analyses concerning the relative merits of sputtering calibration and the effects of evaporation are also included. Author

**N72-21533*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**DISPERSION-STRENGTHENED NICKEL-ALUMINA ALLOY PRODUCED FROM COMMINUTED POWDERS**
Paul F. Sikora and Max Quatinetz Washington Apr. 1972 19 p refs
(NASA-TM-X-2548; E-6791) Avail: NTIS CSCL 11F

An investigation was conducted to determine whether a nickel - 2-volume-percent alumina dispersion-strengthened material with a fine, uniformly distributed dispersoid could be produced, which was equivalent in short time tensile strength to commercially available thoriated sheet materials. Comminution and blending with a modified triple stirrer attritor and a hydrogen and vacuum precleaning treatment prior to consolidation were used. A product with a fine dispersoid with an average particle size of 0.04 micron and an interparticle spacing of 0.7 micron was achieved. This material has a 1093 C (2000 F) short time tensile strength of 117 MN/sq m (16 900 psi). Author

**N72-21534*#** Battelle Memorial Inst., Columbus, Ohio.
**THE ROLE OF GRAIN SIZE AND SHAPE IN THE STRENGTHENING OF DISPERSION HARDENED NICKEL ALLOYS**
B. A. Wilcox and A. H. Clauer Washington NASA Apr. 1972 29 p refs
(Contract NAS3-11167)
(NASA-CR-2025; V6803) Avail: NTIS CSCL 11F

Thermomechanical processing was used to develop various microsstructures in Ni, Ni-2ThO2, Ni-20Cr, Ni-20CR-2ThO2, Ni-20Cr-10W-and Ni-20Cr-10W-2ThO2. The yield strength at 25 C increased with substructure refinement according to the Hall-Petch relation, and substructure refinement was a much more potent means of strengthening than was dispersion hardening. At elevated temperature (1093 C), the most important microstructural feature affecting strength was the grain aspect ratio (grain length, L, divided by grain width, 1. The yield strength and creep strength increased linearly with increasing L/1. Author

**N72-21535*#** Scientific Translation Service, Santa Barbara, Calif.
**INFLUENCE OF CERTAIN PHYSICO-CHEMICAL FACTORS ON THE ADSORPTION CAPACITY OF ACTIVE CARBONS WITH RESPECT TO RHENIUM**
K. B. Lebedev and T. Sh. Tyurekhodzhayeva Washington NASA Apr. 1972 19 p Transl. into ENGLISH from Tr. Inst. Met. Obogashch., Akad. Nauk Kaz. SSR (Kazakh), v. 8, 1963 p 84-96
(Contract NASw-2035)
(NASA-TT-F-14250) Avail: NTIS CSCL 11F

The rhenium adsorption capactiy of AG-3 and AG-N carbons was investigated. It was found that optimum adsorption occurs at room temperature. The admixtures, listed in order of increasing harmful influence on adsorption of rhenium, are: sulfates, chlorides, carbonates, oxysulfides, and xanthates. Author

**N72-21536*#** Scientific Translation Service, Santa Barbara, Calif.
**METALLIC DISPERSONIC AS SOLID SAMPLES IN ATOMIC ABSORPTION**
M. Ghiglione and E. Eljuri Washington NASA Apr. 1972 6 p refs Transl. into ENGLISH from Acta Cient. Venezolana (Caracas), v. 21, no. 3, 1970 p 123-124
(Contract NASw-2035)
(NASA-TT-F-14232) Avail: NTIS CSCL 11F

Colloidal dispersions of metals were obtained by using the metal samples as electrodes in an oscillating spark discharge. The compositions of the resulting highly stable and finely dispersed colloids correctly represent the compositions of the electrodes. These dispersions can be analyzed directly by atomic absorption spectrometry with conventional apparatus. The error is estimated to be about 1%. Two steels were analyzed for Cr by this method. The contents found were 16.19 and 15.99%, respectively, compared with 16.35 and 16.15% obtained by a standard wet chemical method. For the best precision, the samples are weighted before and after the spark discharges. The method can also be applied to nonmetallic conductors. Author

**N72-21537*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**THE KINETIC AND MECHANICAL ASPECTS OF HYDROGEN-INDUCED FAILURE IN METALS Ph.D. Thesis, 1971**
Howard G. Nelson Washington Apr. 1972 143 p refs Prepared jointly with Calif. Univ., (Los Angeles)
(NASA-TN-D-6691; A-4142) Avail: NTIS CSCL 11F

Premature hydrogen-induced failure observed to occur in many metal systems involves three stages of fracture: (1) crack initiation, (2) stable slow crack growth, and (3) unstable rapid crack growth. The presence of hydrogen at some critical location on the metal surface or within the metal lattice was shown to influence one or both of the first two stages of brittle fracture but has a negligible effect on the unstable rapid crack growth stage. The relative influence of the applied parameters of time, temperature, etc., on the propensity of a metal to exhibit hydrogen induced premature failure was investigated. Author

**N72-21538*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**COBALT TUNGSTEN ALLOY Patent Application**
Robert L. Dreshfield, Gary D. Sandrock, and John C. Freche, inventors (to NASA) Filed 26 Jan. 1972 8 p
(NASA-Case-LEW-10436-1; US-Patent-Appl-SN-221093) Avail: NTIS CSCL 11F

Cobalt-tungsten alloys are described, containing titanium, zirconium, carbon, chromium, rhenium, iron and nickel in preferred weight percentage ranges. The alloys have superior strengths at elevated temperatures. The nominal compositions, in weight percentages, of these alloys are 10 to 25% tungsten, 0.5 to 1% titanium, 0.25 to 5% zirconium, 0.1 to 1% carbon, 0 to 5% chromium, 0 to 3% rhenium, 1 to 10% nickel, and the balance cobalt. NASA

**N72-21539#** Virginia Polytechnic Inst., Blacksburg. Dept. of Metals and Ceramic Engineering.
**RELATIONSHIP OF NITROGEN CONTENT TO THE SUSCEPTIBILITY OF AUSTENITIC STAINLESS STEELS TO STRESS CORROSION Quarterly Report, 1 Dec. 1970 - 28 Feb. 1971**
G. S. Clevinger and Jack L. Lytton Apr. 1971 27 p refs
(Contract AT(40-1)-4052)
(TID-25783; QR-3) Avail: NTIS

The relationship of nitrogen content to microstructural inhomogeneities in austenitic stainless steels was investigated. The stress corrosion mechanism in Type 304 and 20% Cr-20% Ni austenitic stainless steel alloys were also studied. Author

**N72-21540#** Brookhaven National Lab., Upton, N.Y.
**CRITICAL TEMPERATURES IN Fe DOPED COPPER-RICH Cu-Ni ALLOYS**
L. H. Bennett (NBS, Gaithersburg, Md.), L. J. Swartzendruber (NBS, Gaithersburg, Md.), and R. E. Watson [1971] 6 p refs Presented at the 17th Ann. Conf. Magnetism and Magnetic Mater., Chicago, 16-19 Nov. 1971 Supported by AEC
(BNL-16276; Conf-711108-4) Avail: NTIS

Systematics of the magnetic ordering behavior as a function of Fe and Ni content were investigated by use of the Mossbauer effect in a series of copper-based alloys containing up to a few percent Fe and up to 40% Ni. The half-width of the magnetic transition is about 1 K in all the weak ferromagnets (i.e., when the critical temperature T sub c < 10 K), and is a similar, or smaller, fraction of T sub c for the strong ferromagnets. The data indicate a sharply defined T sub c for all compostions, despite the distribution of hyperfine fields and magnetic moments existing in the alloys. For any Ni concentration, T sub c increases with increasing Fe content. As a function of Ni, a minimum in T sub c occures near 30% Ni. These results indicate that the long range conduction electron interaction between Fe atoms in Cu is reduced by Ni addition, with the strong short range interactions becoming more important for ferromagnetism at the higher Ni concentrations. Author

**N72-21541#** Oak Ridge National Lab., Tenn.
**COMPATIBILITY OF STRONTIUM COMPOUNDS WITH SUPERALLOYS AT 900 C AND 1100 C**
J. R. DiStefano and R. E. McHenry Nov. 1971 49 p refs
(Contract W-7405-eng-26)
(ORNL-4625) Avail: NTIS

The compatibility of SrTiO3, Sr2TiO4, and SrO with Haynes alloy No. 25, Hastelloy C, and type 316 stainless steel was evaluated in tests for up to 10,000 hr at 900 and 1100 C. Both SrTiO3 and Sr2TiO4 were compatible with all three superalloys at either temperature. A reaction between SrO and Haynes alloy No. 25 and Hastelloy C occurred at 900 C. The reaction was more extensive at 1100 C and also included type 316 stainless steel; however, it appeared to reach steady state after 5000 hr. In commercially produced Hastelloy C or C-276, the reaction with SrO appears to be related to the presence of one or more intermetallic phases. In laboratory heats containing very low silicon but relatively high carbon or in alloys containing very high silicon, these phases do not form and no attack was observed. A theoretical discussion of several types of reactions that could occur in these systems is presented. The effect of an in-growth of zirconium due to decay of Sr-90 is also discussed. A reduction in the room-temperature mechanical properties of Haynes alloy No. 25, Hastelloy C, and type 316 stainless steel was noted after heat treating at 900 or 1100 C. Author (NSA)

**N72-21542#** Aktiebolaget Atomenergi, Stockholm (Sweden).
**STUDIES ON THE THERMODYNAMICS OF THE OXIDATION OF METALS IN HIGH-TEMPERATURE MILIEU**
Derek Lewis, Birgit Svensson, Marian Depourbaix, Karin Johanason, and Kerstin Johansson Feb. 1971 277 p refs
(STU-68-261-U-208) Avail: AEC Depository Libraries

Studies of selected redox equilibria were carried out as part of a program of research on the thermodynamics of mass-transport, deposition, and corrosion in water-cycle power plants. The theoretical part of the work was concerned with the valuation of relevant electrochemical parameters and with the diagrammatic representation of these parameters. It has led to a method for estimating equilibrium constants for aqueous systems at up to 374 C from free energy and entropy data for 25 C and empirical equations for the heat capacities of ions. The experimental part of the work was concerned with the development of methods and apparatus for electrochemical measurements on aqueous systems and molten salts. Electrodes formed with oxide/oxide and oxide/metal couples of iron, nickel, copper, silver, mercury, and antimony in moderately alkaline aqueous systems were studied up to 100 C. Author (NSA)

**N72-21543#** Scientific Translation Service, Ann Arbor, Mich.
**SELECTIVE DEVELOPMENT OF PITS IN A STAINLESS STEEL IN AN OXIDIZING CHLORIDE MEDIUM**
Anne Monnier, Henri Coriou, Gerard Pinard-Legry, and Georges Plante 19 Oct. 1970 5 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 271, no. 16, 19 Oct. 1970 p 981-984 Sponsored by AEC
(AEC-TR-7289) Avail: NTIS

The development of pits in stainless steel exposed to an oxidizing chloride medium is discussed. Descriptions of this type of corrosion are developed by measuring the ionic current distribution near the pit. The current exchanges taking place between the different zones of steel, especially between the active and passive zones is described. The test equipment used and procedures are explained. Author

**N72-21544#** Scientific Translation Service, Ann Arbor, Mich.
**CORROSION OF ZIRCONIUM ALLOYS IN SUPERHEATED STEAM: # RESULTS OF LONG-TERM TESTS**
A. Gruetter Jul. 1970 35 p refs Transl. into ENGLISH of Eidgenoess. Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland, report EIR-184
(AEC-tr-7287; EIR-184) Avail: NTIS Sponsored by AEC

Seven alloys (Ozhennite, Zr-1.5 Nb, Zr-Cu-Fe, Zr-Cr, Zr-Cr-Si, Zircaloy-2, and Zr-2.5 Nb) were investigated for their corrosion chracteristics in 50 atm steam at 350 and 450 C over long periods of time and up to high weight increases. With the exception of Zr-1.5 Nb, an exponent of about 3 at 350 C and one of 2.5 at 450 C was found for all alloys in the pretransition region. Photomicrographs showed voids in all post transition oxides. Crack formation perpendicular to the surface occurred relatively late in the post transition region. With regard to hydrogen absorption, a linear relation with the oxygen absorption was generally found at 450 C in the post transition region. In the pretransition region hydrogen absorption proved to be negligible at 450 C compared to that in the post transition region. NSA

**N72-21545#** Rensselaer Polytechnic Inst., Troy, N.Y.
**STUDY OF THE EFFECT OF HYDROSTATIC PRESSURE ON SELF DIFFUSION RATES IN HEXAGONAL METALS Annual Progress Report**
H. Michael Gilder Oct. 1971 5 p refs
(Contract at(30-1)-3820)
(RPI-3820-5) Avail: NTIS

The thermal expansion coefficient of an activated vacancy in Zn and Cd was found to be alpha sub V = 1/T. Plots of delta H vs p for both metals give slopes of essentially zero. It is shown that the thermal expansion of the activated vacancy can account for the curvature in the Arrhenius plot of Na. A preliminary diffusion run in thallium at 4 kbar and 300 C is reported. The activation volume data for Zn and Cd indicate no anisotropy between the volumes associated with the basal and nonbasal vacancy jumps. NSA

**N72-21546#** Army Foreign Science and Technology Center, Charlottesville, Va.
**DETERMINING THE MECHANICAL PROPERTIES OF SHEET METALS BY USING DATA OBTAINED IN EXPERIMENTS WITH DIAPHRAGMS SUBJECTED TO TRANSVERSAL SHOCK**
A. V. Crushevskii and M. A. Galaburda 21 Oct. 1971 9 p refs Transl. into ENGLISH from Mashinovedenie (USSR), 1969
(AD-735437; FSTC-HT-23-678-71) Avail: NTIS CSCL 11/6

The article concerns the problem of behavior of diaphragms subjected to dynamic loads. The set of equations describing the motion of the diaphragm under impulsive loads is investigated. GRA

N72-21547# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**THERMOPHYSICAL PROPERTIES OF SELECTED ARTICLES**
A. S. Basin, E. E. Shpilrain, I. I. Novikov, M. N. Arnoldov, and I. B. Dmitriev 12 Oct. 1971 123 p refs Transl. into ENGLISH from the monograph "Teplofizicheskie Svoistva Zhidkostei" Moscow, 1970 p 5, 99-154, 161-163
(AD-735467; FTD-MT-24-117-71) Avail: NTIS CSCL 11/6

Contents: The experimental study of temperature dependences of the density of potassium, rubidium, and cesium; The experimental study of caloric properties of binary systems containing cesium; The experimental investigation of the solubility of cesium in lithium in a molten state; The solubility of gases in an eutectic alloy of sodium and potassium; The solubility of oxygen in cesium; The solubility of hydrogen in melts of sodium and the eutectic alloy sodium-potassium; On the question concerning the connection of thermodynamic properties and viscosity of liquid alloys; The mutual influence of gaseous and metallic admixtures on the electrical resistance of molten lithium; The influence of a small addition of sodium on the electrical resistance of lithium; Investigation of the surface tension of molten metals and freons in an atmosphere of internal saturated vapors by the new combined method; The kinetic properties of gaseous, liquid, and solid mercury; The thermophysical properties of liquid mercury. GRA

N72-21548# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**EFFECT OF ALLOYING ELEMENTS ON THE SOFTENING OF IRON BASE AUSTENITIC ALLOYS**
K. V. Gorev and E. P. Pukhovskii 22 Oct. 1971 13 p refs Transl. into ENGLISH from Vestsi Akad. Navuk Belarusk. SSR, Ser. Fiz. Tekhn. Navuk (Minsk), no. 4, 1969 p 16-20
(FTD Proj. 60107)
(AD-735466; FTD-HT-23-1342-71) Avail: NTIS CSCL 11/6

The effect of tungsten and molybdenum on the softening and the structure of chrome nickel austenitic steel was studied. The base of these alloys had the composition 15 percent Cr, 30 percent Ni, 0.5-0.6 percent C, and the remainder was iron. The structure was that of a stable austenitic solid. Author (GRA)

N72-21549# Watervliet Arsenal, N.Y.
**INTERFACIAL ENERGY AND THE HIGH TEMPERATURE STRENGTH OF DISPERSION-STRENGTHENED GOLD-Al2O3 ALLOYS**
Edward S. Chen and Fritz K. Sautter Aug. 1971 22 p refs
(AD-735710; WVT-7153) Avail: NTIS CSCL 11/6

High temperature, low-stress creep studies were conducted on dispersion-strengthened gold-alumina alloys in air. The results show two regions of diffusion creep where the strain rate is a linear function of applied stress. It is suggested that the first creep region in the vicinity of zero strain rate is associated with grain boundary-particle interactions while the second region of higher creep rate, in addition, is due to pore growth. An expression, based on the change in free energy involved in the detachment of grain boundaries pinned by inclusions, was derived to account for the observed threshold stress for creep. A comparison of the calculated values with experimental data shows reasonable quantitative agreement. Author (GRA)

N72-21550# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
**A BRIEF SURVEY ON METAL FATIGUE**
Byoung Sung Kim and A. C. Eringen Nov. 1971 79 p refs
(Contract DAHC04-69-C-0062; DA Proj. 200-61102-B-32-D)
(AD-735700; AMS-1018; TR-28; AROD-8090-7-E) Avail: NTIS CSCL 11/6

The nomenclature of conventional fatigue test and the stress-strain relationship during a cyclic loading are discussed. Prot's method, for a rapid determination of the fatigue limit and statistical approaches to analyze the fatigue data are discussed. The solution of the problems of crack propagation occupy a large portion of the current literature on fatigue research. Short discussions are presented on five different approaches including Griffith's theory and Cherepanov's continuum mechanical approach. Miner's linear cumulative damage theory and various modifications to it are discussed including the effect of a random load. Influence of various factors, such as mean stresses, stress concentration, etc are examined. Thermal fatigue and the corrosion fatigue are briefly introduced. Author (GRA)

N72-21551# National Materials Advisory Board, Washington, D.C.
**CATALOG OF SELECTED REPORTS**
Dec. 1971 31 p refs
(Contract DA-49-083-OSA-3131)
(AD-735150; NMAB-2-C) Avail: NTIS CSCL 11/6

The catalog provides a listing of 64 selected NMAB reports issued from 1965 through 1971, with an abstract of each. GRA

N72-21552# Army Materials and Mechanics Research Center, Watertown, Mass.
**FACTORS INFLUENCING THE STRENGTH DIFFERENTIAL OF HIGH STRENGTH STEELS**
Richard Chait Nov. 1971 25 p refs
(DA Proj. 1T0-61101-A-91-A)
(AD-735314; AMMRC-TR-71-48) Avail: NTIS CSCL 11/6

Room temperature tensile and compressive true stress-true strain curves of various high strength steels (quenched and tempered 4340 steel, 410 martensitic stainless steel and H-11 steel; and aged 300-grade 18 Ni maraging steel) were analyzed to determine the effect of the various microstructures on what has been termed the strength differential (SD), i.e., the strength level difference between the tensile and compressive flow curves. Author (GRA)

N72-21553# National Bureau of Standards, Washington, D.C.
**THE THERMODYNAMICS OF CHEMICAL SPECIES IMPORTANT IN AEROSPACE TECHNOLOGY Interim Report**
Thomas B. Douglas and Charles W. Beckett 1 Jul. 1971 189 p refs
(AF-AFOSR-ISSA-70-0002; AF Proj. 9750-01)
(AD-736039; NBS-10481; AFOSR-71-2584TR) Avail: NTIS CSCL 11/6

A detailed report is presented on recent results and critical analyses of experimental measurements completed or in progress, literature surveys, and new measurement-method developments for high melting metals and their aerospace-important compounds. The report primarily discusses the thermal properties of tungsten, niobium, and molybdenum. Niobium and molybdenum pentafluorides are also discussed. GRA

N72-21554# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
**DEVELOPMENT OF POROUS BERYLLIUM Final Technical Report, 15 May 1969 - 30 Sep. 1971**
Stuart N. Rosenwasser, David M. Goddard, and Michael J. Hovan Wright-Patterson AFB Ohio AFML Jan. 1972 122 p refs
(Contract F33615-69-C-1606; AF Proj. 7351)
(AD-736484; MDC-G2744; AFML-TR-71-241) Avail: NTIS CSCL 11/6

The processing procedures and parameters were developed for the fabrication of uniform controlled permeability porous beryllium billets by cold isostatic pressing and vacuum sintering of fractioned commercial, attritioned powder. Optimized parameters for the production of 1 1/2-in. diameter billets in the permeability range of 1 x 10 to the minus 11th power sq in. to 1 x 10 to the minus 12th power sq in., and 3-in. diameter billets in the permeability range of 5 x 10 to the minus 10th power sq in. to 5 x 10 to the minus 12th power sq in. were derived by an iterative experimental procedure. Author (GRA)

N72-21706# Lincoln Lab., Mass. Inst. of Tech., Lexington.
**OPTICAL PROPERTIES OF ALUMINUM**
G. Dresselhaus, M. S. Dresselhaus, and D. Beaglehole (Maryland Univ.) *In* NBS Electron. Density of States Dec. 1971 p 33-36 refs Sponsored by the AF (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

N72-21907# Leeds Univ. (England). Dept. of Metallurgy.
**THE SCIENCE COMMITTEE CONFERENCE ON THE THEORY OF STRESS CORROSION CRACKING OF ALLOYS**
J. C. Scully *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 6 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

N72-21909# Bell Aerospace Co., Buffalo, N.Y.
**THE pH AND POTENTIAL MEASUREMENTS DURING STRESS CORROSION OF ALUMINUM ALLOYS**
J. A. Davis *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 15 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

N72-21919# Naval Ship Research and Development Center, Annapolis, Md. Corrosion Branch.
**INFLUENCE OF TEST METHOD ON STRESS CORROSION BEHAVIOR OF ALUMINUM ALLOYS IN SEA WATER**
George J. Danek *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 11 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

N72-21920# Aluminum Co. of America, Pittsburgh, Pa. Chemical Metallurgy Div.
**DISCUSSION OF PAPER, INFLUENCE OF TEST METHOD ON STRESS CORROSION BEHAVIOR OF ALUMINUM ALLOYS IN SEAWATER BY GEORGE J. DANEK**
Donald O. Sprowls and J. G. Kaufman *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 7 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

N72-21923# Carpenter Technology Corp., Reading, Pa.
**STRESS CORROSION CRACKING OF MARTENSITIC PRECIPITATION HARDENING STAINLESS STEELS**
Michael Henthorne *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 8 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

N72-21926*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**HOT SALT STRESS CORROSION CRACKING OF TITANIUM ALLOYS: OVERVIEW AND IMPACT ON SPACE SHUTTLE APPLICATION**
W. Barry Lisagor and James E. Gardner *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 10 p refs (See N72-21900 12-32)
(NASA-TM-X-68304) Avail: NTIS CSCL 11F

N72-21927# Battelle Memorial Inst., Columbus, Ohio. Corrosion Research Div.
**THE USE OF SLOW STRAIN RATE EXPERIMENTS IN EVALUATING RESISTANCE TO ENVIRONMENTAL CRACKING**
James E. Reinoehl and Walter K. Boyd *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 5 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

N72-21930# Istituto di Ricerche Breda S.p.A., Milan (Italy).
**PRELIMINARY REPORT ON THE RESEARCH ON THE INFLUENCE OF THERMOMECHANICAL TREATMENTS ON STRESS CORROSION CRACKING BEHAVIOUR OF AISI 4340 STEEL**
R. DeSantis, L. Matteoli, and T. Songa *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 5 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

# 18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N72-21555*# Manlabs, Inc., Cambridge, Mass.
**INVESTIGATION OF THE FRACTURE MECHANICS OF BORIDE COMPOSITES Quarterly Report**
Larry A. Kaufman Jan. 1972 32 p refs
(Contract NASw-2088)
(NASA-CR-126246; QR-5) Avail: NTIS CSCL 11D

Processing studies designed to produce boride composites with metal additives to lower fabrication temperatures and increase the impact strength are reported. Hot pressing experiments were performed with ZrB2 and Fe, Ti, and Zr employed singly as additives. Data for the characterization, impact tests, slow bend tests, and fracture strength are presented. F.O.S.

N72-21556*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
**EVALUATION OF ELASTOMERS AS GASKET MATERIALS IN PNEUMATIC AND HYDRAULIC SYSTEMS**
C. W. Bright and B. J. Lockhart Washington Apr. 1972 26 p refs
(NASA-TN-D-6693) Avail: NTIS CSCL 11A

In the search for superior materials from which to make gaskets for pneumatic and hydraulic systems, promising materials were selected and tested. The testing was conducted in two phases. Those materials that passed the tests of Phase 1 were tested in Phase 2, and categorized in the order of preference.
Author

N72-21557*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**NONFLAMMABLE COATING COMPOSITIONS Patent Application**
Albert C. Krupnick, Carlo F. Key, and Roger J. Harwell, inventors (to NASA) Filed 26 Oct. 1970 14 p
(NASA-Case-MFS-20486; US-Patent-Appl-SN-84212) Avail: NTIS CSCL 11C

The coating compositions are based on an aqueous suspension of synthetic mica or reactive fluorolithosilicate and a soluble metal silicate or sulfate gelant intermixed with a water-base resin emulsion latex paint. Inorganic pigments and additives such as zinc oxide or color pigments and glass microballoons are included to provide the desired color and optical characteristics. Coating compositions are nonflammable in contact with liquid oxygen and high oxygen gaseous environments. Curing of these compositions can be carried out at a considerably lower temperature than for the previous mica-silicate coatings. Mechanical properties, in particular adhesion and film flexibility, are improved. Color and reflectance properties can be adjusted over a wide range by varing the pigments and additives used. NASA

**N72-21558#** Philips Zentrallaboratorium G.m.b.H., Aachen (West Germany).

**CONDUCTIVE COATING FOR SPACE VEHICLES [CONDUCTIVE COATING FUER RAUMFAHRZEUGE]**

H. Koestlin Cologne DGLR Sep. 1971 12 p refs In GERMAN Presented at the 4th DGLR Annual Meeting, Baden-Baden, West Ger., 11-13 Oct. 1971 Sponsored by the Bundesmin. fuer Wiss. und Forsch.

Avail: NTIS

An electrically conductive transparent coating was developed for the Aeros satellite project solar cell cover glasses, in order to establish complete equipotential over the satellite outside surface. The coating materials investigated were doped metal oxides; in particular, indium oxide doped with tin was found to have good properties. The surface resistivity of this layer was between 1 and 10 k Ohm. The effective transparency of the cover glasses was reduced by only 0.5% to 1.5% and the emission power by less than 2%. The layer adhered very well to the glass substrate and under simulated space environment no optical property variations were noticeable although the conductivity increased slightly. ESRO

**N72-21559#** Whittaker Corp., San Diego, Calif. Research and Development Div.

**VISCOELASTIC WAVE PROPAGATION IN UNIDIRECTIONAL COMPOSITES, PART 4 Technical Report, 1 Jun. 1969 - 31 Jul. 1971**

Juan Haener Wright-Patterson AFB, Ohio AFML May 1971 50 p

(Contract F33615-69-C-1367; AF Proj. 7342)

(AD-734658; MJO-3004-Pt-4; AFML-TR-68-311-Pt-4) Avail: NTIS CSCL 11/4

The wave propagation in a unidirectional fibrous composite with viscoelastic components has been studied. A method has been developed by which the attenuation due to any viscoelastic law can be determined. The procedure is based on axial power flow and on radial energy loss, in terms of previously determined displacement fields and viscoelastic material constants. A special example using a Voigt solid has been analyzed and the equation for the viscoelastic constant established. Author (GRA)

**N72-21560#** Army Foreign Science and Technology Center, Charlottesville, Va.

**LONG TERM STRENGTH OF ANISOTROPIC COMPOSITE MATERIALS UNDER PLANE STRESS STATE**

K. V. Zakharov 21 Oct. 1971 11 p refs Transl. into ENGLISH from Mekh. Tverdogo Tela (USSR), 1969

(AD-735434; FSTC-HT-23-673-71) Avail: NTIS CSCL 11/4

Under consideration is the long-term strength of anisotropic composite materials (textolites, fiber glass, etc.) under plane stress. A criterion of strength generalizing the criterion of short-term strength suggested earlier by the author for such materials has been proposed. The theoretical results are illustrated in the case of glassbase textolites with a polyester binder, the most promising materials to be used for various structures designed to work under a load for a lengthy period of time. In his studies of a number of technical materials with an orthogonal anisotropy of mechanical properties (textolites, layered pulp plastics, glass-base textolites, plywood, etc.) the author proposed a short-term strength criterion for complex cases of stress. The criterion was based on the widely assumed validity of modeling a layered medium by the use of a homogeneous elastic anisotropic medium. Author (GRA)

**N72-21561#** Dayton Univ. Research Inst., Ohio.

**KINETICS OF DEGRADATION OF SOME POLYSTYRENES AND COPOLYMERS OF STYRENE AND ACRYLONITRILE Summary Technical Report, Mar. - Sep. 1970**

David R. Bain Jun. 1971 68 p refs

(Contract F33615-69-C-1385; AF Proj. 7340)

(AD-735278; AFML-TR-71-132) Avail: NTIS CSCL 11/9

The kinetics of degradation of some polystyrenes and a series of copolymers of styrene and up to 33.4% acrylonitrile were studies by dynamic thermogravimetry in vacuum. An average activation energy of 42.5 k. cal was found for the entire series independent of composition. The primary effect of the acrylonitrile units is to increase the rate of chain scission and this effect is masked by the overall rapid initial rate of chain scission as the sample temperature is increased. Author (GRA)

**N72-21562#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**CERTAIN PROPERTIES OF COATINGS FROM DRY POLYVINYL BUTYRAL PAINTS SVL-21**

N. Ya. Kestelman, G. S. Marchuk, and I. A. Lapsker 7 Oct. 1971 10 p refs Transl. into ENGLISH from Lakokrasochnye Materialy i ijh Primenenie (Leningrad), no. 4, 1970 p 37-38

(AD-735238; FTD-HT-23-1140-71) Avail: NTIS CSCL 11/3

It is shown that coatings from dry polyvinyl butyral paints SVL-21 excelled in wear resistance and durability and were superior to low pressure polyethylene or polyvinyl butyral KA coatings in microhardness. GRA

**N72-21563#** Naval Ordnance Lab., White Oak, Md.

**FABRICATION AND TESTING OF CARBON FIBER/PHENYLATED POLYQUINOXALINE RESIN COMPOSITES Final Report, Jul. 1969 - Jun. 1971**

Mary Lynda Santelli 18 Nov. 1971 46 p refs

(AD-735876; NOLTR-71-187) Avail: NTIS CSCL 11/4

Techniques were developed for fabricating carbon fiber composites using the high temperature resin, phenylated polyquinoxaline (PPQ). Composites with interlaminar shear and flexural strengths about 80% of those for similar epoxy composites initial strength retention at temperature but significant loss of strength after 168 hours. Author (GRA)

**N72-21564#** Picatinny Arsenal, Dover, N.J. Materials Engineering Div.

**APPLICATION OF SUPERPOSITION TECHNIQUES TO THERMAL DEGRADATION OF EPOXIDE RESINS**

H. T. Lee, Elise McAbee, and David W. Levi Dec. 1971 39 p refs

(DA Proj. 1T0-62105-A-329)

(AD-735687; PA-TR-4261) Avail: NTIS CSCL 11/9

Time-temperature superposition was successfully applied to thermogravimetric (TGA) data for the thermal degradation of a number of cured epoxide resins. For several epoxides and for two curing agents, the same values of log a sub D were applicable. This suggests that the same chemical processes were occurring in all cases, at least up to conversions of about 50%. Since log a sub D was linear with temperature, it also was possible to superpose W versus log T plots at various rates of heating. Once more, the same shift factors (log K) could be applied to all the epoxides studied. Author (GRA)

**N72-21565#** McDonnell-Douglas Astronautics Co., Santa Monica, Calif.

**MULTIAXIAL BEHAVIOR OF ATJ-S GRAPHITE Interim Report, 1 Dec. 1970 - 15 May 1971**

Julius Jortner Wright-Patterson AFB, Ohio AFML Jul. 1971 131 p refs

(Contract F33615-71-C-1143; AF Proj. 7381)

(AD-736470; MDC-G2078; AFML-TR-71-160) Avail: NTIS CSCL 11/3

A program to explore the vehavior of ATJ-S graphite under multiaxial stress states is described. the program includes biaxial tests, off-axis uniaxial tests, and the development of a triaxial test capability. The first phase of the program is to conduct fracture tests on specimens of ATJ-S graphite under biaxial stress states at room temperature and 2000 F at low strain rates. The baxial tests consist of simultaneous axial loading and internal pressurization of hollow cylindrical specimens. The biaxial stress-states investigated include combinations of across-grain tension with with-grain tension, and across-grain compression with with-grain tension. The second phase is to

conduct uniaxial tensile and compressive tests on ATJ-S specimens oriented at 0 degrees, 45 degrees, 70 degrees and 90 degrees to the across-grain axis of the material. Author (GRA)

**N72-21519#** Joint Publications Research Service, Arlington, Va.
**VAPOR PRESSURE AND THERMODYNAMIC FUNCTIONS OF MAGNESIUM CHLORIDE AND POTASSIUM CHLORIDE IN THE TITANIUM SPONGE (GRAPHITE)-CHLORIDE SYSTEM**
V. L. Kurbatov and E. Ye. Lukashenko *In its* Nonferrous Met. 9 Mar. 1972 p 7-13 refs (See N72-21517 12-17)
Avail: NTIS

**N72-21520#** Joint Publications Research Service, Arlington, Va.
**CHARACTERISTIC FEATURES OF INTERACTION OF ZIRCONIUM DIOXIDE WITH CARBON AT HIGH TEMPERATURES**
Yu. A. Pavlov, A. V. Manukhin, and V. F. Melekhin *In its* Nonferrous Met. 9 Mar. 1972 p14-18 refs (See N72-21517 12-17)
Avail: NTIS

**N72-21523#** Joint Publications Research Service, Arlington, Va.
**SOLUBILITY OF CARBON IN NIOBIUM**
I. I. Druzhinin, A. M. Zakharov, and I. I. Novikov *In its* Nonferrous Met. 9 Mar. 1972 p 29-35 refs (See N72-21517 12-17)
Avail: NTIS

**N72-21707#** Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
**ON THE OPTICAL PROPERTIES AND THE DENSITY OF STATES IN ARSENIC**
R. W. Brodersen and M. S. Dresselhaus *In* NBS Electron. Density of States Dec. 1971 p 39-44 refs (See N72-21702 12-26)
(Contract ARPA SD-90)
Avail: SOD $7.75 as C 13.10:323

**N72-21785#** Maryland Univ., College Park. Inst. for Molecular Physics.
**THE EFFECT OF HYDROSTATIC PRESSURE ON THE GALVANOMAGNETIC PROPERTIES OF GRAPHITE**
I. L. Spain *In* NBS Electron. Density of States Dec. 1971 p 717-725 refs Sponsored by AEC (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

# 19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also: 08 Computers.

**N72-21566** National Lending Library for Science and Technology, Boston Spa (England).
**POLYNOMIALS ORTHOGONAL TO HOLOMORPHIC FUNCTIONS OF MANY COMPLEX VARIABLES AND AN ANALOGUE OF THE RIESZ-FISCHER THEOREM**
L. A. Ajzenberg [1971] 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 199, 1971 p 255-257
(NLL-M-22038-(5828.4F)) Avail: Natl. Lending Library, Boston Spa Engl.: 1 NLL photocopy coupon

Theorems are proved concerning functions orthogonal to holomorphic functions. Let D be bounded domain in C to the nth with a piecewise smooth boundary, partial D; and C(partial D) is the space of functions continuous on partial D. The polynomials are dense in C(partial D). The theorem on a complex-valued Borel measure on partial D is regarded as a generalization of the Riesz-Fischer theorem, and is used to describe the orthogonal under integration on partial D to the space O(partial D), a subspace of functions. N.E.N.

**N72-21567*#** National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**AN INDIRECT OPTIMIZATION METHOD WITH IMPROVED CONVERGENCE CHARACTERISTICS Ph.D. Thesis - Houston Univ.**
Harold Hughes Doiron Mar. 1972 124 p refs
(NASA-TM-X-58088) Avail: NTIS CSCL 12A

A method is presented for obtaining numerical solutions to a certain class of two-point boundary value problems which arise in optimal control theory. The problems are characterized by systems of nonlinear ordinary differential equations with nonlinear boundary conditions. Author

**N72-21568*#** Brown Univ., Providence, R.I. Center for Dynamical Systems.
**CONVERGENCE OF THE DISCRETIZATION EQUATIONS WHICH ARISE IN STOCHASTIC CONTROL**
H. J. Kushner Sep. 1971 18 p
(Grants NGL-40-002-015; AF-AFOSR-0693-67; NSF GK-24485)
(NASA-CR-126037) Avail: NTIS CSCL 12A

A problem is considered which arises in the numerical analysis of the degenerate partial differential equations of stochastic control theory. The relationship between diffusions and finite state Markov chains is considered. The role of probability theory in numerical analysis is illustrated. Author

**N72-21569#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Dynamik der Flugsysteme.
**COMPUTATION OF ROOT LOCI USING BRANCH-FOLLOWING TECHNIQUE**
W. Duffek 29 Jul. 1971 104 p refs In GERMAN; ENGLISH summary
(DLR-FB-71-64) Avail: NTIS; DFVLR, Porz-Wahn: 27,70 DM

The mathematical background and the organization of a digital program are presented for computing the root locus of linear, single loop systems with and without a single time delay. The algorithm utilizes the branch-following technique to compute all locus points within a specified region of the complex plane in terms of increasing gain as a real parameter. The program has an automatic stepsize control, which assures that at all branches there are points of equal gain under the computed root loci and that no breakaway points are omitted. Locus and order of breakaway points are computed when they are reached on the branches. Author

**N72-21570#** Aerospace Corp., El Segundo, Calif.
**A GENERAL TRANSPORT RULE FOR VARIABLE MASS DYNAMICS**
Stuart B. Belknap 9 Aug. 1971 29 p refs Backup document for AIAA Synoptic scheduled for publication in the AIAA Journal in Sep. 1972
Avail: NTIS

A general transport rule is presented for variable mass dynamics for application to engineering systems of current interest. The relation is valid for any tensor property associated with either a particle or an increment of distributed mass. It is believed that use of the transport rule contributes a degree of economy and clarity not previously available in variable mass dynamics. Equations of translational and rotational motion are derived in a few steps. Alternate forms are obtained, and the physical significance of certain terms is explained. A jet damping dyadic is defined, and its relationship to the time derivative of the inertia dyadic is clarified. Equations of motion are expressed in forms similar to the familiar relations convenient for constant mass systems. This promotes physical insight and facilitates the

evaluation of relatively small terms. Finally, relations are developed for the motion of a general rocket vehicle. Author

N72-21571# California Univ., Livermore. Lawrence Radiation Lab.
**ITERATIVE IMPROVEMENT APPROACH TO THE NUMERICAL SOLUTION OF VECTOR TOEPLITZ SYSTEMS**
Michael P. Ekstrom 22 Oct. 1971 8 p refs Presented at 5th Asilomar Conf. on Systems and Circuits, Pacific Grove, Calif., 8 Nov. 1971 Sponsored by AEC
(UCRL-73495; Conf-711118-1) Avail: NTIS

An algorithm is presented for the approximate solution of vector Toeplitz systems via an iterative improvement method. The algorithm exploits the special structure of Toeplitz matrices and is particularly suited for solving large systems. Sufficient convergence conditions and concrete error bounds for the iteration are also presented. Author

N72-21572# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.
**ON THE MAXIMUM PRINCIPLE FOR DISCRETE DYNAMICAL SYSTEMS WITH LAGS**
Claude-Alain Burdet and Suresh P. Sethi Nov. 1971 19 p refs
(Contract N00014-67-A-0314-0007; NR Proj. 047-048)
(AD-735475; RR-262) Avail: NTIS CSCL 12/1

The paper presents a discrete formulation of optimal control problems with lags. A maximum principle for such systems is established constructively within the framework of the discrete optimal control theory. The questions of sufficiency and existence are also studied. Author (GRA)

N72-21573# Yale Univ., New Haven, Conn. Becton Center.
**LYAPUNOV FUNCTIONS FOR QUADRATIC DIFFERENTIAL EQUATIONS WITH APPLICATIONS TO ADAPTIVE CONTROL**
Gerd Lueders and Kumpati S. Narendra Dec. 1971 14 p refs
(Contract N00014-67-A-0097-0020)
(AD-735482; CT-47) Avail: NTIS CSCL 12/1

Conditions are derived for the existence of quadratic Lyapunov functions for vector differential equations with quadratic terms. These conditions are used to establish a set of nonlinear equations for which the null solution is asymptotically stable in the whole. Many of the recent results in the stability of Model Reference Adaptive Systems are particular cases of these general conditions. Author (GRA)

N72-21574# Yale Univ., New Haven, Conn. Becton Center.
**ADAPTIVE CONTROL USING LYAPUNOV'S DIRECT METHOD**
Kumpati S. Narendra, Shiva S. Tripathi, Gerd Lueders, and Prabhakar Kudva Oct. 1971 29 p refs
(Contract N00014-67-A-0097-0020; NR Proj. 375-131)
(AD-735481; CT-43) Avail: NTIS CSCL 12/1

The main aim of the report is to make transparent most of the interesting ideas involved in the design of adaptive systems using the direct method of Lyapunov, by considering primarily systems described by first-order differential equations. A study is made of three adaptive designs for such systems. Author (GRA)

N72-21575# Rice Univ., Houston, Tex. Aero-Astronautics Group.
**NUMERICAL EXPERIMENTS ON HESTENES' METHOD OF MULTIPLIERS FOR MATHEMATICAL PROGRAMMING PROBLEMS**
A. Miele, P. E. Moseley, and E. E. Cragg 1971 19 p refs
(Grant NSF GP-27271)
(PB-205311; AAR-85) Avail: NTIS CSCL 12B

Numerical solution is considered for the constrained minimization problem, that is, the problem of minimizing a function f(x) subject to a constraint phi (x) = 0, where f is a scalar, x an n-vector, and phi a q-vector, with q < n. Hestenes' method of multipliers is considered to exhibit better convergence characteristics than the standard penalty function method. An exploration is presented of the method of multipliers in connection with the ordinary and the conjugate gradient algorithms. Author (GRA)

N72-21576# Rice Univ., Houston, Tex. Aero-Astronautics Group.
**A MODIFICATION OF THE METHOD OF MULTIPLIERS FOR MATHEMATICAL PROGRAMMING PROBLEMS**
A. Miele, A. E. Moseley, and E. E. Cragg 1971 23 p refs
(Grant NSF GP-27271)
(PB-205312; AAR-86) Avail: NTIS CSCL 12B

The problem is considered of minimizing a function f(x) subject to a constraint phi(x) = 0, where f is a scalar, x an n-vector, and phi a q-vector, with q < n. A modification of Hestenes' method of multipliers is presented in order to accelerate convergence. The modification consists in imbedding Hestenes' updating rule into a one-parameter family of updating rules and determining the scalar parameter beta, so that total error in the system is minimized, and increasing the updating frequency, so that the number of iterations in a cycle is delta N = 1 for the ordinary gradient algorithm and delta N = n for the conjugate gradient algorithm. The modified method of multipliers exhibits faster convergence than Hestenes' method of multipliers. Author (GRA)

N72-21577# Georgia Univ., Athens. Dept. of Statistics and Computer Sciences.
**PSEUDO RANDOM NUMBER GENERATORS FOR STATISTICAL APPLICATIONS**
Lovick Edward Cannon, III Aug. 1971 164 p refs
(Contract N00014-69-A-0423)
(AD-735144; TR-69; THEMIS-15) Avail: NTIS CSCL 12/1

Pseudo random number generating programs coded in machine language for the IBM 360/65 computer have been prepared for producing random values from the normal, exponential, and gamma distributions as well as from any discrete probability distribution. The schemes are based largely on combinations of sophisticated techniques first suggested by Marsaglia. The distributions simulated are exact within the word size of the computer and average production time per number is very short, e.g. 10 to 40 microseconds depending upon the particular distribution. Author (GRA)

N72-21578# Wisconsin Univ., Madison. Dept. of Statistics.
**STATISTICAL MODELS Annual Report, 1 Jun. 1970 - 31 May 1971**
George E. P. Box May 1971 7 p refs
(Grant AF-AFOSR-1803-69; AF Proj. 9749)
(AD-735197; AFOSR-71-2692TR) Avail: NTIS CSCL 12/1

Efficient planning requires efficient methods for forecasting and control. One of the objects of the present research is to further extend methods described in a recent successful 550 page book by Box and Jenkins developed under AFOSR sponsorship. Non-stationary models which can adequately represent multiple dependent records developing in time have been obtained and efficient methods for identification, estimation and diagnostic checking have been studied. Of particular importance are canonical forms of the model whereby the information contained in many records can often be summarized in a few composite series. Difficult problems in estimation are being approached using Bayesian methods. Two problems occurring in continuous time control theory were studied and results obtained on the accuracy properties of numerical algorithms for approximately solving linear operator equations. Some new results in Bayesian Tolerance Regions have been obtained. Author (GRA)

N72-21579# Army Research Office, Durham, N.C.
**PROCEEDINGS OF THE 1971 ARMY NUMERICAL ANALYSIS CONFERENCE**

Dec. 1971 274 p refs Conf. held at Washington, D. C.
(AD-735690; AROD-71-4) Avail: NTIS CSCL 12/1

Contents: Scratchpad/1 - An interactive facility for symbolic mathematics; Expediting large scale numerical computations by the use of TV techniques; Computer simulation - An essential approach to solve complex biological and environmental problems; Mathematical programming models of an optimal delaying action; The use of multiple regression equations in the campaign execution model; Design of survey systems using nonlinear programming methods; On the rate of change in the solution set of a perturbed linear program; A modified allocation method for computing stress intensity factors; Finite element analysis of buried cylinders; Application of spline interpolation methods to engineering problems; A spline approximation of an empirical displacement field; Modern facilities for man computer interaction; A correcting process designed to control propagated error; Iterative solution of abstract polynomial equations; Rounding; Numerical spectra and applications to computational methods; Low cost interactive computer graphics. GRA

**N72-21580#** Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
**TIME SERIES ANALYSIS AND NONLINEAR FILTERING**
Richard Gran Jan. 1972 31 p refs
(AD-735787; RM-530) Avail: NTIS CSCL 12/1

The identification of the parameters of a linear differential equation model for a system operating in a random (noisy) environment is one of the practical problems that must be overcome before extensive use of optimal control theory is possible. This problem arises in such diverse areas as aircraft control (where stability derivatives are required) and in the reduction of data for ships operating in a random sea. Motivated by these problems, in this memorandum the author describes a promising approach to the identification of the parameters that uses nonlinear filtering theory. Two approximations to nonlinear filters have been tried, one of which gives very good estimates of the unknown parameters. Further, a new third moment filter is described that, while it is not yet tested, offers great promise. Some statistical tests are also described that show when the estimates have converged, and results of numerical experiments are presented. Author (GRA)

**N72-20991#** FIAT S.p.A., Turin (Italy). Flight Mechanics Engineering.
**AN INTEGRAL METHOD FOR EXTRACTION OF AERODYNAMIC COEFFICIENTS FROM FLIGHT-TEST DATA**
G. P. Foroni *In* AGARD Flight Test Tech. Feb. 1972 6 p refs (See N72-20976 12-02)
Avail: NTIS

# 20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

**N72-21581** National Lending Library for Science and Technology, Boston Spa (England).
**FEATURES OF THE DISTRIBUTION OF KINETIC ENERGY OF ATMOSPHERIC MOTIONS OVER THE USSR**
E. N. Ignatjusina [1970] 16 p refs Transl. into ENGLISH from Tr. Nauchn.-Issled. Inst. Aeroklim. (Moscow), v. 69, 1970 p 29-45
(NLL-M-22049-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The vertical and horizontal distribution of kinetic energy in the atmosphere over the U.S.S.R. are studied for January and July. The daily observations of 85 stations in the period 1957 to 1964 are used, and parameters of the free atmosphere at standard heights with 1 km intervals are obtained. The vertical and horizontal distributions of kinetic energy are both significantly inhomogeneous, and a marked difference between the southern and northern portions of Russia are noted. The kinetic energy fluctuations, eddy and mean motions, meridional transfer, and large-scale atmospheric turbulence are discussed, along with the similarities between July and January condition. The contribution of large-scale turbulence to the total kinetic energy is considered to play an exceptionally important part in the atmospheric circulation in summer and winter. N.E.N.

**N72-21582** National Lending Library for Science and Technology, Boston Spa (England).
**SOME ASPECTS OF THE STATISTICAL ANALYSIS OF THE TEMPERATURE REGIME**
V. D. Kaznaceeva [1970] 11 p refs Transl. into ENGLISH from Sredneaz. Nauc-Issled. Gidromet. Inst., T. Vyp. (USSR), v. 47, no. 62, 1970 p 34-46
(NLL-M-22065-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The January and February temperature regime in Tashkent from 1949 through 1964 is analyzed for possible predictands for statistical weather forecasting. Time correlation and spectral functions are obtained for the temperature parameters of daily mean, maximum and minimum, and deviations from the mean for the months in a given year. Periods in the variations of all temperature parameters exist. The statistical analysis was made using expansions in natural orthogonal components for n successive days. Among the conclusions are the following: The first principal component represents the general background of the temperature regime for a period of 8 consecutive days. The second principal component describes a less long-lived component of atmospheric circulation. The relative contribution of the first component is almost halved in 6 to 8 days. An examination of uncorrelated variables indicates that the first component does not always give the most information. In this case the contribution of the second component increases, and the weight given to the two components should depend on the multiple correlation coefficient. N.E.N.

**N72-21583** National Lending Library for Science and Technology, Boston Spa (England).
**TEMPERATURE DISTRIBUTION IN THE NORTH ATLANTIC BEFORE THE SEVERE WINTER OF 1969**
A. N. Kryndin [1971] 8 p refs Transl. into ENGLISH from Glav. Uprav. Gidromet. Sluzh. Met. Gidr. (Leningrad), no. 10, 1970 p 75-78
(NLL-M-22215-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The ocean temperature field, the heat flux between ocean and atmosphere, and their anomalies preceding and during the 1968-1969 winter are analyzed. Data collected onboard transport, fishing, and stationary weather ships are used to draw charts of 10-day and monthly water and water-air temperature anomalies. Two regions were studied: from 5 to 25 deg w, 55 to 63 deg n, in the zone of positive values of the anomalies; and from 30 to 50 deg w, 45 to 55 deg n, in the zone of the negative values. The anomalies in the 1968 autumn and forewinter periods were greater than the standard deviation in the eastern region and equal to it in the west. The heat flux was always from water to air. As a result the heights of isobaric surfaces departed from the normal. Heat flux data for 1948 to 1960 are also analyzed and it is concluded that in the cold half of the year, ocean heat anomalies are dominant in the formation of the monthly and seasonal features of the weather. N.E.N.

**N72-21584** National Lending Library for Science and Technology, Boston Spa (England).
**SOME CLIMATOLOGICAL PARAMETERS OF THE TEMPERATURE FIELD OF THE NORTH ATLANTIC**
A. N. Kryndin [1971] 12 p refs Transl. into ENGLISH from Nauchn. Issled., Inst. Aeroklim. (Moscow), v. 60; 1970 p 26-42
(NLL-M-22214-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Annual variations and long-term variations in North Atlantic temperature are analyzed using the Smed data of monthly temperature anomalies for the centers of 14 standard squares. The investigation is based on data for 1881 to 1962. The high temperatures were found to occur in August, and the lows in February-March, a little later than on land. The annual range of ocean temperature is 5.8 C in the western part and 4.8 C in the eastern. Long-term fluctuations of monthly mean temperatures have ranges of 2 to 6 C. The variations of long-term ranges with respect to time have the greatest values for October and the least values for April; the variations with respect to space are reversed, with the greatest values for April and the least for October, for both eastern and western sections of the Atlantic. The standard deviation of monthly temperatures vary from 0.5 to 1.1 C, which is 10 to 20% of the mean annual range. N.E.N.

**N72-21585** National Lending Library for Science and Technology, Boston Spa (England).

**ASPECTS OF MACHINE CLASSIFICATION OF METEOROLOGICAL ENTITIES AND TYPES OF TEMPERATURE REGIME IN TASKENT IN WINTER**

G. V. Gruza and E. Ja. Rankov [1970] 14 p refs Transl. into ENGLISH from Sred. Nauc.-Issled. Gidromet Inst., T. Vyp. (Leningrad), v. 47, no. 62, 1970 p 10-21
(NLL-M-22039-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The automatic classification of synoptic processes and situations for weather forecasting was studied. The concept of similarity of situation vectors, and the quality of classifications are discussed in terms of algorithms, and averaging within classes. The results of machine classification of temperature regimes for a five day period in Taskent are included. F.O.S.

**N72-21586** National Lending Library for Science and Technology, Boston Spa (England).

**CALENDAR SINGULARITIES OF 24-HOUR AMOUNTS OF RAIN OF 30 mm OR MORE**

L. P. Jakovleva [1970] 9 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 258, 1970 p 81-87
(NLL-M-22061-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The calendar singularities with 30 mm or more rain in 24 hours are determined for northwest European U.S.S.R. Data were taken from 1951 to 1968 during wet and dry periods and summer. These data were compared to determine the days with probable rainfall of 30 mm and less than 30 mm. It was established that on certain days and dates considerable amounts of rain are likely to occur and be quite extensive; and that during certain months more rain is likely to occur. These data are used to predict long range climatological rainfall for the area. E.H.W.

**N72-21587** National Lending Library for Science and Technology, Boston Spa (England).

**PROBLEMS OF THE FOUR-DIMENSIONAL ASSIMILATION OF METEOROLOGICAL OBSERVATIONAL DATA**

L. S. Gandin [1971] 10 p Transl. into ENGLISH from Glav. Uprav. Gidromet. Sluzh., Met. Gidr. (Leningrad), no. 3, 1971 p 15-21
(NLL-M-22063-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The problems in 4-dimensional (space-time) assimilation of meteorological information were studied for objective weather forecasting. Two cases are considered: the discrete and continuous. In the discrete scheme, observational data are inserted in the forecasting model at definite periods, and the system moved along a trajectory allowing for time and changes which occur during the movement. In the continuous model, asynoptic data are included for the time it was made. The forecast is developed in real time reproducing processes at the speed at which they occur. The errors of the input data are examined, and intensive study of the information properties of different forms of meteorological observation, and the parameters describing relationships between observation and numerical forecasting, is recommended. F.O.S.

**N72-21588** National Lending Library for Science and Technology, Boston Spa (England).

**AN INVESTIGATION ON THE DISTRIBUTION OF RAINDROPS ASSOCIATED WITH THE PASSAGE OF COLD FRONT, ESPECIALLY OF COMPARISON BETEEN ECHO INTENSITY MEASURED BY PULSE INTEGRATOR AND RAIN INTENSITY ON THE GROUND**

Mitsuo Hattori [1970] 11 p refs Transl. into ENGLISH from J. Meteorol. Res. (Japan), v. 22, 1970 p 453-459
(NLL-M-22067-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Simultaneous raindrop observations at the Irako Meteorological Station and radar pulse integrator observations at the Nagoya District Meteorological Observatory were compared to describe the rain intensity associated with the passage of a cold front. Raindrops were collected on the filter-paper of an automatic raindrop recorder, from which the drop/min ratio, drop size distribution, and Z-R relation were obtained. From the radar pulse integrator recordings, the radar reflectivity Z sub R was obtained and compared with Z sub f calculated from the raindrops, where the subscripts R and f stand for radar and filter, respectively. The drop size distribution at Irako fitted the M-P distribution and raindrops over 3.0 mm in diameter were rare. A period of 8 minutes of the radar pulse integrator was significant at 5% and the diameter of the cell was estimated to be 6.5 km from the velocity of the cell movement. The best time lag between Z sub R and Z sub f was 3.0 minutes. The correspondence between Z sub R and Z sub f was the closest within a range of 2.0 and to 3.0 m/sec in hypothesized updraft. N.E.N.

**N72-21589*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**WIND VELOCITY PROFILES MEASURED BY THE SMOKE-TRAIL METHOD AT THE EASTERN TEST RANGE, 1964**

James C. Manning, Richard H. Rhyne, and Robert M. Henry Washington Apr. 1972 73 p refs
(NASA-TN-D-6746; L-8205) Avail: NTIS CSCL 04B

Twenty-six detailed wind profiles measured by the smoke trail technique at the Eastern Test Range during the first seven months of 1964 are presented as plots of west-to-east and south-to-north velocity components at height intervals of 25 meters. The overall altitude ranges of the profiles vary from about 2.6 to 19.1 km. The wind measurements, which were made under a variety of conditions, include velocities in excess of the 90- and 95-percent highest values for the Eastern Test Range. The report also includes a listing of the wind profiles, their maximum velocities and direction of the maximum velocities, measured by the smoke trail method at the Eastern Test Range from 1962 to 1964. Author

**N72-21590#** Advisory Group for Aerospace Research and Development, Paris (France).

**ATMOSPHERIC POLLUTION BY AIRCRAFT ENGINES AND FUELS, A SURVEY**

Robert F. Sawyer (Calif. Univ., Berkeley) Mar. 1972 40 p refs
(AGARD-AR-40) Avail: NTIS

A survey of atmospheric pollution by aircraft engines, aircraft fuels, and related research work was conducted among several European nations and the United States. Twenty-seven current or potential problem areas are described. Of these areas, the five most pressing are: (1) engine emission characteristics; (2) test procedures; (3) nitric oxide formation; (4) carbon monoxide and hydrocarbons at low power; and (5) effect of high altitude emissions. It was recommended that research be encouraged in all 27 areas, although in some cases only a better definition of the nature of the problem as opposed to a solution may be required. A selected but extensive bibliography is provided in the appendix. Author

**N72-21591#** World Meteorological Organization, Geneva (Switzerland).

**REPORT OF THE SECOND SESSION OF THE TROPICAL**

**EXPERIMENT BOARD Global Atmospheric Research Programme**
Dec. 1971 41 p Prepared jointly with Intern. Council of Sci. Unions
(GARP-Spec-5) Avail: NTIS

The report the 2nd session of the Global Atmospheric Tropical Experiment (GATE) reviews the decisions and comments of the 6th World Meteorological Congress and presents and discusses the preliminary plan for GATE. The national contributions required are outlined and the organization of a scientific and management group for GATE considered. ESRO

**N72-21592#** Transportation Systems Center, Cambridge, Mass.
**SURVEY OF AIRCRAFT EMISSIONS AND RELATED INSTRUMENTATION Technical Report, 1 Jul. 1970 - 31 Mar. 1971**
Anthony J. Broderick, Walter F. Harriott, and Robert A. Walter
31 Mar. 1971 37 p refs
(PB-204794; DOT-TSC-OST-71-5) Avail: NTIS CSCL 13B

The report presents the preliminary results of a survey of transportation systems emissions monitoring requirements. Emissions of carbon monoxide, hydrocarbons, oxides of nitrogen and particulates from aircraft power plants, with emphasis on gas turbine engines, are considered. Measurement rationale for various types of aircraft is summarized. Instrumentation available for measuring these emissions is reviewed and a tabulation made of those techniques in current use. Instrumentation requiring further engineering development is briefly discussed.
Author (GRA)

**N72-21593#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**SOME FEATURES OF THE USER OF LINEAR DISCRIMINANT ANALYSIS FOR FORECASTING**
M. G. Ter-Mkrtchyan and L. Ye. Lukiyanov 21 Oct. 1971 24 p refs Transl. into ENGLISH from Tr. Gidrometeorol. Nauch.-Issled. Tsentr SSSR (USSR), no. 44, 1969 p 67-81
(FTD Proj. 60103)
(AD-735468; FTD-MT-24-1403-71) Avail: NTIS CSCL 04/2

Some problems involved in improving the model for predicting the monthly quantity of precipitation based on discriminant analysis are presented. The authors discuss selection of the optimum vector predictor. An algorithm is proposed for finding the order of preferableness and the optimum number of predictors for an alternative forecast. In the case of classification into three classes, a stochastic triangle is used in investigating the form of classification regions of both identical and unidentical losses. The proposed method is used in day to day practice. Author (GRA)

**N72-21594#** Naval Weather Service Command, Washington, D.C.
**SUMMARY OF SYNOPTIC METEOROLOGIC OBSERVATIONS: SOUTHWEST ASIAN COASTAL MARINE AREAS. VOLUME 3: AREA 9, CAPE COMORIN; AREA 10, MANGALORE; AREA 11, PANJIM, AREA 12, BOMBAY**
Dec. 1971 723 p
(AD-735441) Avail: NTIS HC $9.00/MF $0.95 CSCL 04/2

The data contained in these tables were obtained from tape data Family 11 (TDF022), Marine Surface observations. TDF-11 was primarily funded by the Naval Weather Service Command and selected by NWSED Asheville as the most comprehensive collection of marine surface observations from which to develop a series of coastal marine summaries. GRA

**N72-21595#** Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
**LANCE 12805, MISSILE NO. 2107, ROUND NO. 139 (10 DECEMBER 1971) Meteorological Data Report**
Dec. 1971 71 p
(DA Proj. 1T6-65702-D-127)
(AD-735361; DR-683) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 12805 Lance, Missile Number 2107, Round Number 139 SBT, are presented in tabular form. Author (GRA)

**N72-21596#** Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
**LANCE 12802, MISSILE NO. 2130, ROUND NO. 136 (3 DECEMBER 1971 Meteorological Data Report**
Dec. 1971 58 p
(DA Proj. 1T6-65702-D-127)
(AD-735364; DR-679) Avail: NTIS

Meteorological data gathered for the launching of 12802 Lance, Missile Number 2130, Round Number 164, are presented in tabular form. Author (GRA)

**N72-21597#** Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
**HONEST JOHN 03702, MISSILE NO. 621, ROUND NO. 615 AML (16 DECEMBER 1971) Meteorological Data Report**
Dec. 1971 26 p
(DA Proj. 1T6-65702-D-127)
(AD-735362; DR-684) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 03702 Honest John, Missile Number 621, Round Number 615 AML, are presented in tabular form. Author (GRA)

**N72-21598#** Little (Arthur D.), Inc., Cambridge, Mass.
**EVALUATION OF COMMUNITY ODOR EXPOSURE**
David A. Kendall, ed. and Thomas Lindvall, ed. Apr. 1971 38 p refs Conf. held at Cambridge, Mass., 26-29 Apr. 1971
(Contract CPA-70-67)
(PB-204989; APTD-0846) Avail: NTIS CSCL 13B

A symposium was held to deal particularly with the evaluation of the effects of odorous exposure in the community, as well as to review recent studies of dose, response, and dose response relationships. The report includes the following topics: human reactions to odors; data on adverse human reactions to odor; empirical data on odor exposure from different sources; sensory analysis; dose-response relationship; interaction between odor sources and other environmental conditions; and temperal pattern. GRA

**N72-21599#** National Science Foundation, Washington, D.C.
**WINTER OROGRAPHIC CLOUD MODIFICATION EXPERIMENT IN THE ROCKY MOUNTAINS OF COLORADO Final Environmental Impact Statement**
29 Dec. 1971 20 p refs
(PB-205277-F; ELR-1509) Avail: NTIS CSCL 13B

From November through April, orographic clouds are randomly seeded with silver iodide from ground generators in the vicinity of Climax, Colorado, in order to study cloud and precipitation processes involved in increasing the snowpack. The target area includes parts of Eagle, Lake, Park, Pitkin, and Summit Counties. The net increase in snowfall over the target area is approximately 20 percent for the 6 winter months. Adverse effects are the increase in snowpack requiring removal in the target area, downwind, and the possible inhibition of growth of aquatic microorganisms by the silver content of freshwater bodies. Author (GRA)

**N72-21600#** Hawaii Univ., Honolulu. Dept. of Meteorology.
**SUMMER CIRCULATION AND WEATHER OVER THE KORAT PLATEAU, THAILAND**
Gordon Ing Nov. 1971 58 p refs
(Contract F19628-71-C-0072; AF Proj. 6698)
(AD-735283; AFCRL-71-0404; UHMET-71-04; SR-1) Avail: NTIS CSCL 04/2

The recurring circulation patterns that are observed over Indochina in the lower and middle troposphere are related to cloudiness and rainfall on the Korat Plateau in Thailand during

the summer. The average and strong monsoon patterns are most often associated with cloudy skies and increased rainfall whereas the weak monsoon patterns are most often associated with clear skies and decreased rainfall. The diurnal cycle in the kinematic and thermodynamic structure of the atmosphere over the plateau is studied. Author (GRA)

N72-21601# Stanford Research Inst., Menlo Park, Calif. Physical Sciences Div.
**ANALYSIS OF TECHNIQUES FOR DESCRIBING THE STATE OF THE SKY THROUGH AUTOMATION Final Report**
R. O. Duda, R. L. Mancuso, and P. F. Paskert Jul. 1971 167 p refs
(Grant ESSA-E-203-69N; DOT-FA65WAI-96; SRI Proj. 7935)
(AD-735213; FAA-RD-71-52) Avail: NTIS CSCL 04/2

The problem of automatically describing cloud amount and cloud base height is studied through the use of statistical analysis and computer simulation. A simulation program is used to determine the response of a set of instruments to simulated cloud conditions. Relations are derived between the accuracy of cloud amount estimation and the number of instruments used, area covered, mean cloud size, cloud speed, sampling interval, and averaging time. Various clustering procedures are evaluated for use in determining the number of cloud layers, the mean height of each layer, and the cloud amount in layers. The physical limitations of such instruments as vertically-pointing ceilometers and scanning lidar systems are discussed. Finally, a simple cost comparison is made between the present manual and a possible automatic system. Author (GRA)

N72-21602# RAND Corp., Santa Monica, Calif.
**A SIMPLE MODEL TO ELUCIDATE THE UTILITY OF WEATHER FORECASTING IN MILITARY OPERATIONS: WEATHER AND WARPLANES 3**
R. R. Rapp Aug. 1971 26 p refs
(Contract F44620-67-C-0045)
(AD-735261; R-774-PR) Avail: NTIS CSCL 04/2

A simple model is constructed to demonstrate the influence of weather forecasts on operational decisions. The model indicates that the present forecasting capability can reduce the number of futile attempts to destroy targets, with only a slight cost in time to accomplish the objective. Some implications are given for optimizing the method of presenting weather forecasts. Author (GRA)

N72-21603# Michigan Univ., Ann Arbor.
**WIND AND TEMPERATURE STRUCTURE IN THE SURFACE LAYER OF THE ATMOSPHERE Final Report, 26 Jan. 1967 - 30 Sep. 1970**
Edward Ryznar Dec. 1971 95 p refs
(Contract DAHC04-67-C-0027)
(AD-735393; AROD-6784-2-EN; Rept-08635-1-F) Avail: NTIS CSCL 04/2

Wind and temperature profiles and turbulent fluctuations of wind velocity and temperature were measured simultaneously for various conditions of horizontaly homogeneous turbulence. Turbulent fluxes of momentum and heat were computed with the profile data using the logarithmic wind profile and the Monin-Obukhov and Businger-Dyer models for turbulent turbulent transfer. Turbulent fluctuations of temperature and the longitudinal, lateral, and vertical wind velocity components were processed in terms of intensity and spectral characteristics. Author (GRA)

N72-21604# National Weather Service, Silver Spring, Md. Techniques Development Lab.
**DEVELOPING TECHNIQUES FOR AUTOMATED FORECASTING OF CLEAR AIR TURBULENCE Final Report**
Frank Lewis, Douglas R. Greene, Robert E. Saffle, and Benjamin W. Helmick Nov. 1971 39 p
(Contract DOT-FA69WA-155)
(AD-735941; FAA-RD-71-102) Avail: NTIS CSCL 04/1

The work reported is directed toward adapting the scheme developed by the Stanford Research Institute for automated forecasting of Clear Air Turbulence (CAT). An important element of the scheme is the relation of CAT occurrence to meteorological parameters. Multi-dimensional contingency tables are developed for specifying the probability of occurrence of CAT from values of meteorological parameters. The table generating procedure will require modification to solve the problem of the sparsity of data which occurs in some of the cells of the tables. Nevertheless, the reductions of variance obtained with the developmental set of data suggest that multi-dimensional contingency tables may produce effective specification of the probability of CAT from meteorological parameters in an automated system. Author (GRA)

N72-21605# Office of Naval Research, London (England).
**ORTHOGONAL FUNCTIONS IN NUMERICAL WEATHER PREDICTION: SOME RESEARCH IN DENMARK AND FINLAND**
Seymour L. Hess 30 Dec. 1971 10 p refs
(AD-735896; ONRL-R-46-71) Avail: NTIS CSCL 04/2

Research in numerical weather prediction is described at the University of Copenhagen (spectral method) and at the University of Helsinki (empirical orthogonal functions). The Copenhagen group has succeeded in formulating a consistent set of truncation conditions for the primitive equations, reducing the large demands for computer time of the spectral method and making it possible to introduce physical effects such as condensation and radiation. At Helsinki formalisms have been developed for applying empirical orthogonal functions to numerical forecasts. Systematic errors can be reduced, random errors can be lowered and the length of useful forecast time can be extended. The possibility is pointed out of generating probable alternate forecasts which may reveal the areas of likely failure of the physical forecast and supply probable alternates. Author (GRA)

N72-21606# Air Force Global Weather Central, Offutt AFB, Nebraska.
**AFGWC MACRO-SCALE UPDATE FORECAST MODEL**
James Kerlin 1 Nov. 1971 18 p refs
(AD-735742; AFGWC-TN-71-3) Avail: NTIS CSCL 04/2

The Air Force Global Weather Central (AFGWC) macro-scale update forecast model is specifically designed to be compatible with the macro-scale baroclinic prediction model, which produces forecasts of height, wind, and temperature at six levels (850, 700, 500, 300, 200, and 100 mb) for an octagonal (hemispheric) grid. The update model produces six to 36 hour updated forecasts for window areas of 15x15 to 35x35 grid points (381 km spacing) which may be located anywhere within the octagon. The model is employed whenever required to update areas of the hemispheric forecasts which were initally data-deficient so as to significantly degrade the forecast. Stream functions are forecast at six levels and are used as input to solve the diagnostic omega equation, from which vertical velocities are obtained for solution of the vorticity equation for a new stream function tendency. The time step is 45 minutes. Horizontal boundary conditions are determined from the hemispheric forecasts being updated. Author (GRA)

N72-21607# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
**THE 12804 LANCE, MISSILE NO. 2120, ROUND NO. 137 Meteorological Data Report for 7 December 1971**
Dec. 1971 78 p
(DA Proj. 1T6-65702-D-127)
(AD-735359; DR-680) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 12804 Lance, Missile Number 2120, Round Number, 137, are presented in tabular form. Author (GRA)

N72-21608# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
**THE 11604 LANCE, MISSILE NO. 5129, ROUND NO. 138 RMT Meteorological Data Report for 9 December 1971**
Dec. 1971 52 p
(DA Proj. 1T6-65702-D-127)
(AD-735360; DR-682) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 11604 Lance, Missile Number 5129, Round Number 138 RMT, are presented in tabular form. Author (GRA)

N72-21609# North American Weather Consultants, Goleta, Calif.
**A HYDROMETEOROLOGICAL DATA APPRAISAL AND DESIGN STUDY IN CERTAIN RIVER BASINS IN THE WESTERN UNITED STATES**
Jul. 1971 361 p refs
(Contract DI-14-06-D-7053)
(PB-204939; Rept-15-15) Avail: NTIS HC $6.00/MF $0.95 CSCL 04B

The report is an appraisal to the adequacy of present hydrometeorological information in 5 Western basins for atmospheric water resources planning in the mid-1970's. The 5 basins are: the Missouri, the Snake, the Bear-Wasatch, the North Platte, and the Rio Grande. Recommendations and preliminary designs for supplementing the existing network are included. Data requirements for atmospheric water resource planning are defined largely by reference to the cloud seeding models and special climatologies now used. Author (GRA)

N72-21610# Air Force Global Weather Central, Offutt AFB, Nebraska.
**VERIFICATION DATA: AFGWC MACRO-SCALE BAROCLINIC PREDICTION MODEL Technical Note, Jun. - Sep. 1971**
James Kerlin 1 Nov. 1971 43 p
(AD-735737; AFGWC-TN-71-6) Avail: NTIS CSCL 04/2

Forecasts produced by the AFGWC Macro-Scale Baroclinic Prediction Model are compared with observational data from rawinsonde sites. Monthly summaries are included for June, July, August and September 1971. These summaries include frequency distribution and error statistics for 12, 24, 36 and 48 hours forecasts at 850, 500, 300 and 100 mb. Meteorological parameters verified are temperature, D-value and winds. Author (GRA)

N72-21611# Air Force Global Weather Central, Offutt AFB, Nebraska.
**VERIFICATION DATA: AFGWC 1000 mb MACRO-SCALE PREDICTION MODEL Technical Note, Jun. - Sep. 1971**
James Kerlin 1 Nov. 1971 21 p
(AD-735740; AFGWC-TN-71-9) Avail: NTIS CSCL 04/2

Forecasts produced by the AFGWC 1000 mb Macro-Scale Prediction Model are compared with observational data from RAWINSONDE sites. Monthly summaries are included for June, July, August and September 1971. These summaries include frequency distribution and error statistics for 12, 24, and 36 hour forecasts of temperature and D-value. Author (GRA)

N72-21612# Air Force Global Weather Central, Offutt AFB, Nebraska.
**VERIFICATION DATA: AFGWC MACRO-SCALE CLOUD MODEL Technical Note, Jun. - Sep. 1971**
James Kerlin 1 Nov. 1971 32 p
(AD-735739; APGWC-TN-71-8) Avail: NTIS CSCL 04/2

Forecasts produced by the AFGWC Macro-Scale Cloud Model are compared with observational cloud and RAWINSONDE data for the area of the N. American NWP grid. Statistical summaries are included for June, July, August and September 1971. Summaries include frequency distribution and error statistics for 12, 24, 36 and 48 hour forecasts of total cloud coverage, as well as temperatures and dew point depressions at the 850, 700, 500, and 300 mb levels for all months except July. Author (GRA)

N72-21613# Air Force Global Weather Central, Offutt AFB, Nebraska.
**VERIFICATION DATA: AFGWC LIMITED AREA MESO SCALE PREDICTION MODEL Technical Note, Jun. - Sep. 1971**
James Kerlin 1 Nov. 1971 47 p
(AD-735738; AFGWC-TN-71-7) Avail: NTIS CSCL 04/2

Forecasts produced by the AFGWC Meso-Scale Prediction Model are compared with observational RAWINSONDE data from stations within the N. American verification window. Statistical summaries are included for June, July, August, and September 1971. Summaries include frequency distribution and error statistics for 12 and 24 hours forecasts of temperature, D-value and wind at the 850, 700 and 500 mb levels. Author (GRA)

N72-21614# Weather Wing (5th), Langley AFB, Va.
**THE USE OF DIURNAL TEMPERATURE AND DEW POINT CURVES**
Stanley J. Kimball, Norman N. Richardson, Dean H. Frey, and Ronald F. Madsen 3 Jan. 1972 25 p refs
(AD-735276; Rept-5WWTN-72-1) Avail: NTIS CSCL 04/2

The paper describes the basic design of computer produced diurnal temperature and dew point tables and graphs and their use in short-range forecasting. Author (GRA)

N72-21615# Weather Squadron (24th), Laredo AFB, Tex. Detachment 18.
**TERMINAL FORECAST REFERENCE FILE Final Report**
8 Dec. 1971 50 p refs
(AD-735791) Avail: NTIS CSCL 04/2

The reference file discusses factors affecting the Weather at Laredo AFB, Texas. Included are location and topography, weather controls, climatic aids, and local forecast studies. Author (GRA)

N72-21616# Weather Wing (3rd), Offutt AFB, Nebr.
**THERMAL PARAMETERS AS A PREDICTOR OF PRECIPITATION TYPE FOR LORING AFB, MAINE Aerospace Sciences Technical Note**
Limon E. Fortner, Jr. and Dale G. Rogers Sep. 1971 21 p refs
(AD-735724; Rept-3WWTN-71-3) Avail: NTIS CSCL 04/2

The paper presents a summary of thermal parameters as predictors of precipitation type at Loring AFB, Me. The material presented in this paper may be used to make an objective forecast when the input data is extracted from current observations and prognostic facsimile charts. The Caribou, Me, radiosonde data (0000Z and 1200Z) is correlated against precipitation type that occurred at Loring AFB, Me. Thermal parameter combinations used in this study are: 1000-850 mb thickness, 1000-700 mb thickness, 1000-500 mb thickness; surface, 950 mb, 850 mb and 700 mb temperatures. Author (GRA)

N72-21617# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
**THE 12806 LANCE, MISSILE NO. 2112, ROUND NO. 135 EST (30 NOVEMBER 1971) Meteorological Data Report**
Nov. 1971 25 p
(AD-735358; DR-678) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 12806 Lance, Missile Number 2112, Round No. 135 EST, are presented in tabular form. Author (GRA)

N72-21618# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
**THE 12802 LANCE, MISSILE NO. 2105, ROUND NO. 134 SBL (23 NOVEMBER 1971) Meterological Data Report**

Nov. 1971 57 p
(AD-735357; DR-677) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 12802 Lance, Missile Number 2105, Round Number 134 SBL are presented in tabular form. Author (GRA)

**N72-21619#** Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
**THE 11601 LANCE, MISSILE NO. 2171, ROUND NO. 132 RBT (12 NOVEMBER 1971) Meteorological Data Report**
Nov. 1971 69 p
(AD-735356; DR-676) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 11601 Lance, Missile Number 2171, Round Number 132 RBT, are presented in tabular form. Author (GRA)

**N72-21620#** Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
**THE 12802 LANCE, MISSILE NO. 2132, ROUND NO. 133 SBT Meteorological Data Report**
Nov. 1971 62 p
(AD-735355; DR-675) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 12802 Lance, Missile Number 2132, Round Number 133 SBT, are presented in tabular form. Author (GRA)

**N72-21621#** Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
**THE 08510 HONEST JOHN, MISSILE NO. 354, ROUND NO. 613 RML (2 NOVEMBER 1971) Meteorological Data Report**
Nov. 1971 19 p
(AD-735354; DR-674) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 08510 Honest John, missile number 354, round number 613 RML, are presented in tabular form. Author (GRA)

**N72-21622#** Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
**METEOROLOGICAL APPLICATIONS OF THE BIDIRECTIONAL THERMISTOR MASS FLOW RATE SENSOR**
J. R. Rowland Jun. 1971 48 p refs
(Contract N00017-62-C-0604)
(AD-736152; APL-TG-1165) Avail: NTIS CSCL 04/2

A thermistor mass flow rate sensor has been applied to a number of meteorological sensing instruments. These instruments include an aircraft airspeed indicator, an aircraft angle of attack meter, a wind velocity indicator, an atmospheric gravity wave meter, an accelerometer, and a momentum raindrop disdrometer. Included are the basic design details and sample calibrations for each device. Author (GRA)

**N72-21623#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**METHOD OF SOLVING THE NONLINEAR PLANETARY PROBLEM OF THE LONG RANGE FORECASTING OF METEOROLOGICAL ELEMENTS**
E. N. Blinova 15 Nov. 1971 37 p refs Transl. into ENGLISH from TR. Gidrometeorol. Nauch.-Issled. Tsentr SSSR (USSR), no. 31, 1968 p 3-25
(AD-736485; FTD-MT-24-1411-71) Avail: NTIS CSCL 04/2

The method of linearization of equations of hydrodynamics with respect to purely zone motion is widely used in (1) hydrodynamic studies of atmospheric movements on a planetary scale, (2) the construction of a hydrodynamic theory of long-range weather forecasting and a theory of climate, and (3) the practice of long-range forecasting. In most cases, the corresponding linear problems have a precise analytical solution and therefore are free from the accumulation of errors which frequently accompany the approximate finite difference solutions to nonlinear problems. It is also reported that some precise particular solutions of prognostic nonlinear problems have been found. These nonlinear solutions can be used for constructing a new method of calculation, in which the advantages of having the analytical solutions are combined with the refinement of the physics of the process because of the nonlinearity consideration. Author (GRA)

# 21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

**N72-21624*** Stanford Univ., Calif.
**SPACECRAFT ATTITUDE CONTROL METHOD AND APPARATUS Patent**
Thomas R. Kane and Mark P. Scher, inventors (to NASA) Issued 25 Jan. 1972 9 p Filed 31 Dec. 1969 Supersedes N70-22304 (08 - 09, p 1682) Sponsored by NASA
(NASA-Case-HQN-10439; US-Patent-3,637,170; US-Patent-Appl-SN-889551; US-Patent-Class-244-1SA) Avail: US Patent Office CSCL 17G

A method and apparatus are described for controlling the attitude motions of a spacecraft or other artificial body moving in space by causing certain components to perform prescribed motions relative to one another so as to convert the initial motion of the spacecraft into one of simple rotation. The system includes a means for sensing the instantaneous motion of the body, means for computing the necessary relative motion between components to achieve the desired attitude motions, and means for physically implementing the required relative motion. The computing means may either be carried in the moving body or be remote and communicatively linked to the sensing and controlling apparatus.
Official Gazette of the U.S. Patent Office

**N72-21625*#** Sierra Research Corp., Buffalo, N.Y.
**DESIGN STUDY OF GENERAL AVIATION COLLISION AVOIDANCE SYSTEM**
M. R. Bates, L. D. Moore, and W. V. Scott Mar. 1972 243 p refs
(Contract NAS1-10653)
(NASA-CR-112023; TR-0913A) Avail: NTIS CSCL 17G

The selection and design of a time/frequency collision avoidance system for use in general aviation aircraft is discussed. The modifications to airline transport collision avoidance equipment which were made to produce the simpler general aviation system are described. The threat determination capabilities and operating principles of the general aviation system are illustrated. Author

**N72-21626#** *Transportation Systems Center, Cambridge, Mass.*
**EVALUATION OF AIR TRAFFIC CONTROL MODELS AND SIMULATIONS**
*L. O. Higgins and P. Mpontsikaris (MIT)* Jun. 1971 317 p refs
(Contract DOT-TSC-77)
(DOT-TSC-FAA-71-7) Avail: NTIS HC $6.00/MF $0.95

A bibliography of air traffic control models and simulations is presented. A summary of the models which may be of value for air traffic control concept evaluation, with emphasis on traffic flow, safety, and system loading aspects, is included. The models are divided into seven categories as follows: (1) airport surface traffic, (2) runway, departure/arrivals, (3) terminal area, (4) enroute, (5) air traffic control systems models, (6) cost effectiveness models, and (7) safety related models. Approximately 200 reports are identified. Author

**N72-21627#** Transportation Systems Center, Cambridge, Mass.
**MICROWAVE SCANNING BEAM APPROACH AND LANDING SYSTEM PHASED ARRAY ANTENNA Annual**

Report, Jul. 1970 - Jul. 1971
R. M. Kalafus, G. J. Bishop, G. G. Haroules, P. Harris, F. J. LaRussa, P. J. Pantano, B. Rubinger, and R. S. Yatsko Sep. 1971 314 p refs
(DOT-TSC-FAA-71-29) Avail: NTIS HC $6.00/MF $0.95

The feasibility of the use of phased arrays for the proposed microwave landing guidance system (MLGS) is discussed. The effects of the use of planar and conical beam guidance on the choice of system configurations is investigated. The design of an experimental antenna to demonstrate feasibility is given. Author

**N72-21628#** Transportation Systems Center, Cambridge, Mass.
**ACCURATE SURVEILLANCE IN THE TERMINAL AREA Final Report**
Bernhard Kulke, Robert T. Minkoff, and George G. Haroules Sep. 1971 41 p refs
(DOT-TSC-FAA-71-26) Avail: NTIS

The problem of deriving surveillance information from the Microwave Landing System (MLS) has been analyzed in terms of the available air-to-ground communication links. The results of this study indicate that the use of this approach is feasible, and it is recommended that the configuration based on the Discrete Address Beacon System (DABS) data link be included in the upgraded third-generation design to meet the high-density terminal-area surveillance requirements. Author

**N72-21629#** Transportation Systems Center, Cambridge, Mass.
**OCEANIC SURVEILLANCE AND NAVIGATION ANALYSIS, FY 71 Final Report**
Ronald M. Hershkowitz Jun. 1971 83 p refs
(DOT-TSC-FAA-71-13) Avail: NTIS

The results of an oceanic surveillance and navigation analysis for improved commercial aircraft operation over the North Atlantic Ocean are presented. Subjects discussed are: (1) the North Atlantic Systems Planning Group collision risk model, (2) the impact of inertial navigation on air safety, and (3) modeling techniques required to assess the effect of air traffic control by satellite surveillance on separation standards. Author

**N72-21630#** Transportation Systems Center, Cambridge, Mass.
**EVALUATION OF THE FAA ADVANCED FLOW CONTROL PROCEDURES**
J. F. Bellantoni, J. R. Coonan, and M. F. Medeiros Jan. 1972 213 p refs
(DOT-TSC-FAA-72-8) Avail: NTIS

An evaluation of the present Federal Aviation Administration Flow Control Procedures is presented. The evaluation is based on fast-time digital simulation of traffic feeding into the New York City airports. The effectiveness of the flow control procedures is discussed in theory. The following recommendations are made: (1) retain the concept, (2) modify the procedures, (3) modify the computer program, and (4) conduct further research. Author

**N72-21631*#** National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
**IMPROVED SATELLITE AIDED VEHICLE AVOIDANCE SYSTEM Patent Application**
Ernest R. Steele, inventor (to NASA) Filed 21 Jan. 1972 31 p
(NASA-Case-ERC-10419; US-Patent-Appl-SN-219722) Avail: NTIS CSCL 17G

An improved satellite aided vehicle avoidance system (SAVAS) is described. The exact range from a protected vehicle to an intruding vehicle with mutual-collision heading and velocity is derived without signal transmission by the protected vehicle or use of synchronized time reference devices. Additional steps of measuring time-to-collision from the delay and Doppler measurements, establishing ordered time-slots from the form of the satellite signal may be included. NASA

**N72-21632*#** National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
**TERMINAL GUIDANCE SYSTEM Patent Application**
Shu W. Gee, inventor (to NASA) Filed 6 Mar. 1972 27 p
(NASA-Case-FRC-10049-1; US-Patent-Appl-SN-232021) Avail: NTIS CSCL 17G

The guidance system is composed of a heading command subsystem and a glide slope command subsystem. The heading subsystem is responsive to certain input data and continuously develops command signals for use in directing the aircraft from a remote location to a terminal point. The glide slope command subsystem is responsive to certain other input data and continuously develops command signals for use in controlling the rate of descent of the aircraft at the terminal point. NASA

**N72-21633*#** Bellcomm, Inc., Washington, D.C.
**EQUILIBRIUM PROPERTIES OF THE SKYLAB CMG ROTATION LAW**
B. D. Elrod and G. M. Anderson 31 Mar. 1972 80 p refs
(Contract NASW-417)
(NASA-CR-126140; TM-72-1022-2) Avail: NTIS CSCL 22B

The equilibrium properties of the control moment gyroscopes of the Skylab are discussed. A rotation law is developed to produce gimbal rates which distribute the angular momentum contributions among the control moment gyroscopes to avoid gimbal stop encounters. The implications for gimbal angle management under various angular momentum situations are described. Conditions were obtained for the existence of equilibria and corresponding stability properties. Author

**N72-21634#** Transportation Systems Center, Cambridge, Mass.
**AN AIRPORT AIRSIDE SYSTEM MODEL**
Irwin Englander Jun. 1971 55 p refs
(PB-204802; DOT-TSC-OST-71-12) Avail: NTIS CSCL 17G

The model of an airport airside system simulates aircraft operations and controller functions in the terminal area, both in the air and on the ground. The model encompasses all operations between the terminal gate and the point of handoff between the enroute controller and the terminal controller.
Author (GRA)

**N72-21635#** RCA International Service Corp., Patrick AFB, Fla.
**OMEGA SHORT-TERM RANGING PRECISION**
Frank R. Leslie AFETR Nov. 1971 34 p refs Presented at the Omega Symp. of the Inst. of Navigation, Washington, D. C., Nov. 1971 Prepared for Pan Am. World Airways, Inc., Patrick AFB, Fla.
(Contracts F08606-68-C-0040; PAA-72-0040-01)
(AD-735372; ETR-TR-71-6; Tech-Paper-1100-71-1) Avail: NTIS CSCL 17/7

The accuracy of the Omega navigation system may be improved from one nautical mile to approximately 0.1 nautical mile by a technique called 'Precision Omega'. Improving the short-term precision through the use of a four-range least-squares position solution, and removing the bias by reference to navigation satellite position fixes results in a daytime accuracy of 590 ft (180m). Author (GRA)

**N72-21636#** Mitre Corp., Bedford, Mass.
**RECURSIVE NAVIGATION PROGRAM DESCRIPTION AND CHARACTERISTIC PERFORMANCE, AS INDICATED BY SIMULATION AND ANALYSIS**
Robert C. Snodgrass Oct. 1971 128 p refs
(Contract F19628-71-C-0002; AF Proj. 5170)
(AD-735262; MTR-2143; ESD-TR-71-362) Avail: NTIS CSCL 17/7

The report provides a current program description of, and shows the capabilities indicated by, the recursive navigation simulation. Two sets of simulation data are examined in some detail; one resembling the PLRACTA Demonstration testbed and one characteristic of a large tactical area with many aircraft. It will be shown that performance can be predicted with some confidence for certain specific situations. Author (GRA)

N72-21637# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**METHODS OF NAVIGATION AND GUIDANCE BASED ON INCOMPLETE STATISTICAL DATA**

I. A. Boguslavskii 14 Oct. 1971 338 p refs Transl. into ENGLISH of the book "Metody Navigatsii i Upravleniya po Nepolnoi Statistcheskoi Informatsii" Moscow, Izdalelstvo Mashinostroyeniye, 1970 p 1-256

(AD-735605; FTD-HT-23-1057-71) Avail: NTIS HC $6.00/MF $0.95 CSCL 12/1

The book presents principles of the theory of automatic vehicle control based on imcomplete data. Basic attention in it is paid to selecting the recurrent navigation and control algorithms based on digital statistical data. Methods are presented for processing the data with various statistical properties when estimating the phase coordinates of linear and nonlinear dynamic systems. Recurrent equations for the analysis and synthesis of the stochastic bounded equation are obtained. Idealized examples are examined for optimum stochastic homing and command guidance with extensive instrument extensive instrument errors and random errors in the data sensors, vigorous maneuvering of the stabilization circuit. Numerical methods are used to study the influence of control constraints on homing accuracy and average power expenditures. Author (GRA)

N72-21638# Army Electronics Command, Fort Monmouth, N.J.

**DESCRIPTION OF A LORAN-C PROPAGATION ANOMALY AND ASSOCIATED COORDINATE CONVERSION PROBLEMS**

C. W. Anderson, D. C. Pearce, and J. W. Walker Dec. 1971 67 p refs

(DA Proj. 1T0-61102-B-31-A)

(AD-735680; ECOM-3514) Avail: NTIS CSCL 17/7

In order to achieve better accuracy in position determinations when Loran-C manpack systems are used in a mountainous region, the authors initiated an empirical program to describe the Loran-C environment in the vicinity of an isolated terrain feature. Emphasis was placed on variations in the lines of constant time difference over small areas, particularly on what impact these time difference variations have on time difference to Universal Transverse Mercator coordinate conversion. Author (GRA)

N72-21639# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

**SPACE PROGRAMS Quarterly Progress Report, 1 Apr. - 30 Jun. 1971**

30 Jun. 1971 21 p refs

(Contract N00017-62-C-0604)

(AD-735169; APL-U-SQR/71-2) Avail: NTIS CSCL 17/7

Activities are reported in the following categroies: Geoceiver evaluation; NAVOCEANO Geoceiver Navigation Program; USAF Loran-D Grid calibration; advance navigational techniques; AN/SRN-9 logistic support; Deep Submergence Project; Project Magnet GASS System integration, RP-3D aircraft; and a Data Rate Smoothing System for the Manned Flight Support Network. Author (GRA)

N72-21640# Army Electronics Command, Fort Monmouth, N.J.

**SELECTED APPROACHES TO MEASUREMENT PROCESSING AND IMPLEMENTATION IN KALMAN FILTERS**

J. Knight, W. Light, and M. J. Fisher Nov. 1971 34 p refs

(DA Proj. 1F1-62202-AA-91)

(AD-735331; ECOM-3510) Avail: NTIS CSCL 17/7

Selected implementations of Kalman Filters for a LORAN/Inertial navigation system are presented. The approaches differ in the techniques employed for processing measurements of the system. Simulation results are compared and indicate the relative differences in position accuracies of each type of filter. From these results, recommendations are made as to future Kalman mechanizations and evaluation criteria. Author (GRA)

N72-21641# Federal Aviation Administration, Washington, D.C. Office of Management Systems.

**AIR TRAFFIC PATTERNS FOR IFR AND VFR AVIATION, CALENDAR YEAR 1970**

Nov. 1971 154 p

(AD-735970) Avail: NTIS CSCL 17/7

The report presents a detailed record of flight plans filed at flight service stations and combined station/towers as collected in a 2-percent random sample of all Instrument Flight Rules (IFR) and Visual Flight Rules (VFR) flight plans filed in the 50 states and the ARTC area of San Juan, Puerto Rico. These data furnished the various Offices and Services of the Federal Aviation Administration with Terminal and en route air traffic activity for use in planning and management of the air traffic control system. Author (GRA)

N72-21642# International Business Machines Corp., Gaithersburg, Md. Federal Systems Div.

**NORTH ATLANTIC SATELLITE ATC-CENTER STUDY Final Report, 18 Aug. 1970 - 19 Apr. 1971**

C. E. Bading, A. W. Brownfield, W. D. Coulopoulos, R. P. Davis, and W. L. Dunham 19 Apr. 1971 292 p refs

(Contract DOT-TSC-50)

(PB-204862) Avail: NTIS CSCL 17G

A study of present oceanic ATC methods leads to the conclusion that ATC in the North Atlantic should continue to be based on an organized track concept in those areas where traffic densities are high. However, there is clearly a need to improve communications in the North Atlantic area, and a satellite system can provide both communications and surveillance services. The Satellite Oceanic Control Center (SOCC) described is highly automated. In implementing such a system it appears desirable initially to use surveillance data derived from the Inertial Navigation System (INS) and transmitted via data link to the control center. Subsequently, independent surveillance data could be implemented by a two-satellite tone ranging scheme, with the aircraft transponding encoded pressure altitude. Author (GRA)

N72-21643# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**ERRORS IN A SYSTEM FOR THE AUTONOMOUS DETERMINATION OF THE COORDINATES OF A MOVING OBJECT IN THE PRESENCE OF DRY FRICTION**

O. P. Boichuk 18 Oct. 1971 11 p Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 7, 1970 p 620-624

(AF Proj. 7343)

(AD-734920; FTD-HC-23-880-71) Avail: NTIS CSCL 17/7

An investigation of a one component variant of an inertial navigation system with integral horizon correction is given. The problem of determining platform fluctuation in the presence of dry friction in the accelerometer is formulated, and attention is given to the errors in autonomous coordinate determination. Author (GRA)

N72-21222# Teldix Luftfahrt-Ausruestungs G.m.b.H., Heidelberg (West Germany).

**SYSTEMS TASKS FOR ADVANCED AIRCRAFT NAVIGATION SYSTEMS**

F. G. Unger and R. S. Sindlinger *In* AGARD Computers in the Guidance and Control of Aerospace Vehicles Feb. 1972 p 117-130 refs (See N72-21211 12-08)

Avail: NTIS

# 22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

**N72-21644*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**METHOD AND APPARATUS FOR CONTROLLING THERMAL NUCLEAR REACTORS Patent**
John L. Power, inventor (to NASA) Issued 30 Nov. 1971 6 p Filed 10 Feb. 1970 Supersedes N70-35522 (08 - 19, p 3594)
(NASA-Case-XLE-05799; US-Patent-3,624,241; US-Patent-Appl-SN-10162; US-Patent-Class-176-86L) Avail: US Patent Office CSCL 18I

A power control system for a thermal nuclear reactor utilizes core tubes containing a solid sorbent, a thermal neutron absorbing material in ionic form, and a circulating aqueous solution. Control of the reactor is achieved by regulating the amount and distribution of the ionic poison retained by the solid sorbent in the core tubes. The amount of poison retained by the solid sorbent is regulated by controlling the chemical composition of the circulating solution. This regulation may be assisted by altering the chemical properties of the solid sorbent while the reactor is operating. Official Gazette of the U.S. Patent Office

**N72-21645*#** Aerojet Nuclear Co., Idaho Falls, Idaho.
**FLOWING GAS, NON-NUCLEAR EXPERIMENTS ON THE GAS CORE REACTOR Phase 1 Topical Report**
J. F. Kunze, D. H. Suckling, and C. G. Copper Feb. 1972 99 p refs
(NASA Order C-59718B)
(NASA-CR-120824; ANCR-1032) Avail: NTIS CSCL 18I

Flow tests were conducted on models of the gas core (cavity) reactor. Variations in cavity wall and injection configurations were aimed at establishing flow patterns that give a maximum of the nuclear criticality eigenvalue. Correlation with the nuclear effect was made using multigroup diffusion theory normalized by previous benchmark critical experiments. Air was used to simulate the hydrogen propellant in the flow tests, and smoked air, argon, or freon to simulate the central nuclear fuel gas. All tests were run in the down-firing direction so that gravitational effects simulated the acceleration effect of a rocket. Results show that acceptable flow patterns with high volume fraction for the simulated nuclear fuel gas and high flow rate ratios of propellant to fuel can be obtained. Using a point injector for the fuel, good flow patterns are obtained by directing the outer gas at high velocity along the cavity wall, using louvered or oblique-angle-honeycomb injection schemes. Author

**N72-21646*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**NEUTRONICS ANALYSIS OF AN OPEN-CYCLE HIGH-IMPULSE GAS CORE REACTOR CONCEPT**
Charles L. Whitmarsh, Jr. Washington Apr. 1972 37 p refs
(NASA-TM-X-2534; E-6390) Avail: NTIS CSCL 18I

A procedure was developed to calculate the critical fuel mass, including the effects of propellant pressure, for coaxial-flow gas-core reactors operating at 196,600 newtons thrust and 4400 seconds specific impulse. Data were generated for a range of cavity diameter, reflector-moderator thickness, and quantity of structural material. Also presented are such core characteristics as upper limits on cavity pressure, spectral hardening in very-high-temperature hydrogen, and reactivity coefficients.
Author

**N72-21647*#** Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
**AFTER HEAT DISTRIBUTION OF A MOBILE NUCLEAR POWER PLANT Final Report**
W. G. Parker, L. E. VanBibber, and Y. S. Tang Nov. 1971 202 p refs
(Contract NAS3-14405)
(NASA-CR-120825; WANL-PR(WWW)-11) Avail: NTIS CSCL 18I

A computer program was developed to analyze the transient afterheat temperature and pressure response of a mobile gas-cooled reactor power plant following impact. The program considers (in addition to the standard modes of heat transfer) fission product decay and transport, metal-water reactions, core and shield melting and displacement, and pressure and containment vessel stress response. Analyses were performed for eight cases (both deformed and undeformed models) to verify operability of the program options. The results indicated that for a 350 psi (241 n/sq cm) initial internal pressure, the containment vessel can survive over 100,000 seconds following impact before creep rupture occurs. Recommendations were developed as to directions for redesign to extend containment vessel life.
Author

**N72-21648#** Oak Ridge National Lab., Tenn.
**MODEL FOR THE ECONOMIC ANALYSIS OF HIGH LEVEL RADIOACTIVE WASTE MANAGEMENT**
R. S. Dillon, J. J. Perona, and J. O. Blomeke Nov. 1971 79 p refs
(Contract W-7405-eng-26)
(ORNL-4633) Avail: NTIS

The economic analysis encompasses interim liquid storage of the high-level fission product wastes, solidification, interim solid storage, shipment, and final storage in salt mines. Economic data obtained from each of the five waste management steps are subjected to a discounted cash-flow calculation using a specified rate of return to arrive at a levelized incremental power cost necessary to recover all waste management costs. The economic model is structured to perform either a government financing calculation or a calculation indicative of private financing. The program provides detailed cost summaries of the capital and operating expenses for each of the management steps, including the incremental power cost for each step. The total levelized cash flow required for the operation and the maximum unrecovered capital are also generated. Minimum total costs for five different schedules of waste management operations were calculated for a nominal 20,000-MW(e) nuclear economy of typical light water reactors.
Author (NSA)

**N72-21649#** Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik.
**PRESSURE LOSS AND HEAT TRANSFER ON SMOOTH AND ROUGH SURFACES AT HIGH TEMPERATURES AND TURBULENT FLOW AND THEIR REPRESENTATION BY UNIVERSAL LAWS**
E. Meerwald May 1971 98 p refs In GERMAN; ENGLISH summary
(NP-19112) Avail: AEC Depository Libraries

Experiments were performed with 15 different electrically heated rough rods at surface temperatures up to 1200 C, contained in concentric smooth tubes. Heat transfer and friction correlations were developed for turbulent flow in annulus having a repeated rib roughness. The friction correlation is based on a law of the wall similarity. The heat transfer correlation is based on application of a heat-momentum transfer analogy to flow over a rough surface. The friction correlating parameter and the heat-momentum analogy correlation is compared with other roughnesses found in the literature.
Author (NSA)

**N72-21650#** Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt.
**MILD STEEL IN THE PRIMARY CIRCUIT OF WATER COOLED REACTORS**
K. Videm, L. Lunde, S. Aas, and K. Fjellestad Sep. 1971 19 p refs
(HPR-143) Avail: AEC Depository Libraries

A study, initiated in the late 1950's, of the properties of mild steel in a boiling water reactor environment in which the steam pipes of the Halden Boiling Water Reactor were made of mild steel. The work was continued in the 1960's with loop experiments and by exposing specimens in various locations in the primary system of the reactor. Since 1964 the specimens were exposed continuously and certain aspects of the corrosion problem were studied by loop experiments. In order to gain experience with major pieces of equipment, a subcooler heat exchanger made of mild steel was installed in the primary circuit in 1967. The unit was removed in 1970 and inspected. The results since 1964 are summarized. Author (NSA)

**N72-21651#** Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Construction Dept.
**EXPERIMENTAL INVESTIGATION OF MOMENTUM AND HEAT TRANSFER IN TURBULENT FLOW OF AIR IN A FUEL ASSEMBLY MODEL**
J. Vicek 1971 16 p refs
(ZJE-111) Avail: AEC Depository Libraries

The distribution of rods in a fuel assembly is usually calculated assuming that there is no turbulent mixing of coolant among adjoining circular rows of rods and that all the heat generated in a rod is transferred into the subchannel corresponding to the rod under consideration. This problem was solved experimentally using an arrangement of smooth heated rods situated in a circular channel. The experimental efforts was performed on an air loop with an inlet pressure of 5 kp/sq cm, the maximum value of Re being 20,000. Author (NSA)

**N72-21652#** Aktiebolaget Atomenergi, Studsvik (Sweden).
**SCANDINAVIAN PCRV MODEL PROJECT: THERMAL INSULATION TESTS**
W. Kraemer (Allmanna Svenska Elektriska A.B.), G. Jhernborg, S. Menon, and B. Johnsson [1971] 18 p Presented at the 1st Intern. Conf. on Structural Mech. in Reactor Technol., Berlin, 20-24 Sep. 1971
(Conf-710903-6) Avail: AEC Depository Libraries

The Scandinavian PCRV concept is characterized by a removable insulation, allowing for erection of the insulation outside the pressure vessel, for repair of the insulation if serious defects should arise after many years of operation, and for inspection of the vessel liner. The insulation, as well as the space between the insulation and the vessel liner, are filled with gas or alternatively with water. A multipurpose test facility was built in mainly for testing the designs of the removable lid and of the insulation systems. The model can be pressurized either by cold or hot water or by saturated steam up to 85 bar (300 C). A first test series was concluded in December 1970. This series included operation at service conditions (70 bar, 285 C) and at design pressure (85 bar, 300 C) with gas and water-filled insulation, tests with vessel pressure oscillations, transient tests including fast depressurization of the steam dome or sudden flooding of the insulation system with hot water near saturation temperature. The excellent performance of the insulation system is demonstrated by typical temperature maps. Author (NSA)

**N72-21653#** Idaho Nuclear Corp., Idaho Falls.
**MONITORING AND PRETREATMENT ANALYSIS: RADIOACTIVE WASTE MANAGEMENT**
Cyril M. Slansky 1 Oct. 1971 13 p refs Presented at IAEA Regional Training Course in Radioact. Waste Management, Tokyo, 4-24 Nov. 1971
(Conf-711113-3) Avail: NTIS

The monitoring of radioactive wastes released to the environment is discussed in terms of purpose, overall programs, sampling methods, and the analysis of samples. Methods for determining the radioisotope content in the atmosphere, fresh water, seawater and soils are briefly described. NSA

**N72-21654#** Oak Ridge National Lab., Tenn. Neutron Physics Div.
**FAST REACTOR SHIELDING ACTIVITY NO. 40 01 61, 189A NO. 10028 [illegible]v Progress Report, Oct. 1971**
F. R. Mynatt, C. E. Cl[illegible]o, M. L. Gritzner, R. E. Maerker, and D. M. McGregor 24 Nov. 1971 40 p refs
(ORNL-TM-3639) Avail: NTIS

Progress in developing reactor shielding for the fast test and liquid metal fast breeder reactors is reported. Data are also given for the effects of stored fuel on capacity requirements and the effects of neutron streaming in a fission gas plenum on shielding requirements. E.H.W.

**N72-21655#** Oak Ridge National Lab., Tenn.
**REFERENCE DESIGN OF A 3 kW(e) STEAM RANKINE CYCLE SYSTEM FOR AN ISOTOPE POWER PLANT**
A. P. Fraas Nov. 1971 34 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2961) Avail: NTIS

A reference design for a 3 kW(e) steam Rankine cycle system was evolved for undersea applications. The system makes use of a heat block-shield assembly designed so that it is suitable for use with an organic Rankine cycle system or a thermoelectric system as well as the subject steam system. Only the initial development phase was completed. The principal uncertainties and development problems associated with the proposed reference design are associated with the turbine generator pump unit. These include the problem of obtaining high reliability in the bearings, freedom from deterioration of the generator windings as a consequence of moisture permeation into the electrical insulation, and possible corrosion of the magnetic material exposed to steam in the generator.
Author (NSA)

**N72-21656#** Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
**FPMS LIFE TEST Annual Report**
L. E. VanBibber Jul. 1971 30 p
(Contract AT(30-1)-4219)
(WANL-4219-1) Avail: NTIS

The SNAP-23A fueled prototype mockup system has been on system thermal and life test since February 1970. It has accumulated 11,560 hrs of testing through June 30, 1971 of which 9930 were accumulated on life test with the prototype mockup converter PMC-3. On June 30 the system was producing 66 watts at an overall efficiency of 6.2%. The fuel power level was 1053 W corresponding to 4.7 yrs from the nominal fuel design loading of 1180 W. During the life test period the system has performed as predicted without any apparent degradation of system components and interfaces. The only change in performance was that due to fuel decay. Author (NSA)

**N72-21657#** Argonne National Lab., Ill.
**NONDESTRUCTIVE ASSAY OF EBR-2 FUEL PINS**
R. W. Brandenburg Sep. 1971 10 p
(Contract W-31-109-eng-38)
(ANL-7839) Avail: NTIS

The expanding safeguards program and the increasing use of reactors as a source of power point up the desirability of having a program to assay large quantities of reactor fuel. The use of gamma-ray assay as an effective means of verifying U-235 content for accountability purposes is discussed. There were 3423 fuel pins assayed; the difference between the fuel content as determined by gamma assay and that reported by the vendor was less than 1% at the 95% confidence level.
Author (NSA)

**N72-21658#** Idaho Nuclear Corp., Idaho Falls.
**RADIOACTIVE WASTE MANAGEMENT IN RELATION TO THE ENVIRONMENT**
Cyril M. Slansky 10 Sep. 1971 15 p refs Presented in IAEA Regional Training Course in Radioactive Waste Management, Tokyo, 4-24 Nov. 1971
(Conf-711113-2) Avail: NTIS

The effects on the environment of radioactive wastes which

are produced by nuclear power generation and which are released to the environment are discussed. This type of waste accounts for 99% of all radioactive waste released to the environment and includes generally low-level gaseous, liquid, and solid wastes from operating reactors and fuel reprocessing plants. Separate brief discussions of the effects on the atmospheric, marine, and fresh water environments and on soils are presented. NSA

**N72-21659#** Naval Research Lab., Washington, D.C. Reactor Materials Branch.
**IRRADIATION EFFECTS OF REACTOR STRUCTURAL MATERIALS Quarterly Progress Report, 1 Aug. - 31 Oct. 1971**
L. E. Steele, J. R. Hawthorne, P. Shahinian, H. H. Smith, F. A. Smidt, Jr., H. E. Watson, J. A. Sprague, and C. Z. Serpan, Jr. 15 Nov. 1971 52 p refs
(Contract AT(49-5)-2110)
(AD-735872; NRL-MR-2369) Avail: NTIS CSCL 18/10

The report includes: (1) an analysis of notch toughness of AISI 304 and 316 stainless steel submerged arc weldments, (2) information on fatigue crack growth in austenitic stainless steel welds, (3) an analysis of residual element effects on radiation strengthening in iron alloys, pressure vessel steels and welds, (4) electron microscopy observations of defect aggregates in irradiated iron and 0.3 copper-iron alloy, and (5) the development of a damage function for 550 F (288 C) embrittlement of A302-B steel. Author (GRA)

# 23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

**N72-21660** National Lending Library for Science and Technology, Boston Spa (England).
**THE THEORY OF AIR RESTRICTION OF NOISE WITHIN CYLINDRICAL SHELLS**
L. Cremer [1971] 21 p refs Transl. into ENGLISH from Charlottenburg-Berlin Tech. Univ. report
(NLL-M-22125-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Sound transmission impedance and contributing factors are considered for a cylindrical steel shell. These factors include inertia, bending rigidity, and a component due to shell elongation. Assuming a statistical distribution of the dynamic angle in all directions, a flat frequency pattern was calculated for the sound restriction. Author

**N72-21661*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**IMPROVED METHODS OF PERFORMING COHERENT OPTICAL CORRELATION**
Akram S. Husain-Abidi Washington Apr. 1972 15 p refs
(NASA-TN-D-6581; G-0000) Avail: NTIS CSCL 20F

Coherent optical correlators are described in which complex spatial filters are recorded by a quasi-Fourier transform method. The high-pass spatial filtering effects (due to the dynamic range of photographic films) normally encountered in Vander Lugt type complex filters are not present in this system. Experimental results for both transmittive as well as reflective objects are presented. Experiments are also performed by illuminating the object with diffused light. A correlator using paraboloidal mirror segments as the Fourier-transforming element is also described. Author

**N72-21662*#** National Academy of Sciences-National Research Council, Washington, D.C.
**OPTICAL DATA PROCESSING USING PARABOLOIDAL MIRROR SEGMENTS Patent Application**
Akram S. Husain-Abidi, inventor (to NASA) Filed 22 Feb. 1972 19 p Sponsored by NASA
(NASA-Case-GSC-11296-1; US-Patent-Appl-SN-228109) Avail: NTIS CSCL 20F

The paraboloidal reflecting surfaces of the optical data system are segments of a paraboloidal mirror. A source of coherent light is in the focal plane of the first paraboloidal mirror segment which collimates the beam and reflects it toward a second paraboloidal mirror surface. The information to be analyzed, on a transparency for example, is placed in the collimated beam. The beam is reflected from the second paraboloidal mirror segment and focused on a Fourier transform plane. A photon detector could be placed in the Fourier transform plane or suitable spatial filters can be placed there, with the filtered beam then being reflected from a third paraboloidal mirror segment to be focused on a reconstruction plane. NASA

**N72-21663*#** Bellcomm, Inc., Washington, D.C.
**PHYSICAL CORRECTION FILTER FOR IMPROVING THE OPTICAL QUALITY OF AN IMAGE Patent Application**
Shui Yee Lee, inventor (to NASA) Filed 16 Jul. 1971 38 p
(Contract NASw-417)
(NASA-Case-HQN-10542-1; US-Patent-Appl-SN-163151) Avail: NTIS CSCL 20F

A family of physical correction filters is described. Each filter is designed to correct image content of a photographed scene of limited resolution. Each filter includes a first filter element with a pinhole through which light passes to a differential amplifier. The filter also includes a second filter element through which light passes through one or more openings whose geometric configuration is a function of the cause of the resolution loss. The light, passing through the second filter element, is also supplied to the differential amplifier. The amplifier output is used to activate an optical display or recorder to reproduce a photograph or display of the scene in the original photograph with resolution which is significantly greater than that characterizing the original photograph. NASA

**N72-21664#** Compagnie Francaise Thomson Houston-Hotchkiss Brandt, Paris. Lab. Central de Recherches.
**STUDY OF PROPERTIES OF PHOTOCHROMATIC MATERIALS AND DETERMINATION OF THEIR DYNAMICAL AND OPTICAL CHARACTERISTICS [ETUDE DES PROPRIETES DES MATERIAUX PHOTOCHROMIQUES ET DETERMINATION DE LEURS CARACTERISTIQUES DYNAMIQUES ET OPTIQUES]**
J. Sevin 10 Jul. 1970 167 p refs In FRENCH
(Contract DGRST-69-02-039-00-212-75-01)
(LCR-DR-70-90/1/R) Avail: NTIS

General laws, leading to curves valid for photochromic materials incorporated in plastic media are reviewed. An account is given of measurements and characteristic curves obtained with a number of photochromic materials, including salicylidene aniline, spiropyrans, benzothiazolic spiropyrans, mercury dithizonates, and zinc dithizonate. Author (ESRO)

**N72-21665#** Kiruna Geophysical Observatory (Sweden).
**UNUSUAL POLARIZATION EFFECT OBSERVED ON INTELSAT 2F-1 TRANSMISSIONS**
Sixten Olsson and Ludwik Liszka Jan. 1972 17 p refs
(KGO-721) Avail: NTIS

Polarization measurements at the Kiruna Observatory were made using a Titheridge-type polarimeter with a mechanically rotated antenna. The measurements indicate that during spring and summer months, signals from the quasi-geostationary satellite Intelsat 2F-1 at 136.44 MHz are, polarized in a direction around the direction of magnetic field lines. Results indicate that the phenomenon seems to be a propagation effect. Author (ESRO)

N72-21666# ILC, Inc., Sunnyvale, Calif.
**HIGH POWER ALKALI VAPOR LAMPS Semiannual Technical Report, 5 Mar. - 31 Oct. 1971**
Lowell Noble Nov. 1971 65 p refs
(Contract N00014-71-C-0183; ARPA Order 306)
(AD-735951; R-ILC-71-29) Avail: NTIS CSCL 20/6

The objective of this contract is to develop and deliver prototype 8kW (input) alkali vapor lamps that emit 2 kW of output radiation in the major pumping bands of Nd:YAG laser material. The lamps are to be 10 inches long and 18mm or less in diameter; be readily recycled, and provide operational lifetimes of 100 hours or more. Lamps with transparent sapphire envelopes, 14.5mm in bore diameter, were built and operated successfully at input powers per unit length of 0.5kW/inch, more than one-half the design goal. These lamps were more efficient in pumping Nd:YAG than krypton arc lamps of the same length and input power, in spite of the fact that the alkali vapor pressure has not yet been adjusted to provide optimal spectral matching to the laser pumping bands. Also, tests on smaller bore lamps indicate that adding excess of argon or mercury to the standard K-Rb fill does not produce significant improvements in spectral matching. Spectrophotometric and calorimetric equipment developed for the program is described. Author (GRA)

N72-21667# Michigan State Univ., East Lansing. Dept. of Chemistry.
**SPECTROSCOPIC STUDIES IN THE FAR INFRARED Final Report**
G. E. Leroi Dec. 1971 10 p refs
(Contract N00014-68-A-0109-0004)
(AD-735945) Avail: NTIS CSCL 07/4

Infrared spectroscopic research carried out at Princeton University and Michigan State University is briefly summarized, and publications arising from the work are listed. Author (GRA)

N72-21668# Rome Air Development Center, Griffiss AFB, N.Y.
**WAVEFRONT DISTORTIONS CAUSED BY THERMALLY INDUCED MIRROR DEFORMATIONS**
Robert F. Ogrodnik Nov. 1971 147 p refs
(AD-735282; RADC-TR-71-271) Avail: NTIS CSCL 20/6

Mirror distortions can seriously hamper coherent signal detection, employed in laser radar, especially in high power applications. These distortions reduce signal sensitivity by reducing the heterodyne efficiency of coherent optical detection due to the induced wavefront phase mismatch between signal and the optical local oscillator. This study analyzes thermally induced mirror distortions which occur when the mirror face is heated by intense, Gaussian distributed laser radiation. These distortions are derived by considering the body strains brought about by the longitudinal and radial temperature gradients generated within the mirror. Conditions affecting reduced mirror distortions are then determined by examining the effects of base cooling on the radial temperature variation throughout the thickness of the mirror. These results are applied to the metals invar, brass, aluminum, copper and silver in an effort to determine the metal and cooling conditions which will provide minimum distortions over a wide range of kilowatt laser power levels and power distributions. Author (GRA)

N72-21669# Electro-Optical Systems, Inc., Pomona, Calif.
**IMAGE RECORDING SYSTEM, LOW LIGHT (IRSLL), PHASE A Final Report**
Louis H. Reynolds, II Nov. 1971 232 p refs
(Contract DAAD07-71-C-0136)
(AD-735830) Avail: NTIS CSCL 17/8

A study was made of the requirements and approaches appropriate to an Image Recording System, Low Light (IRSLL). The IRSLL will be used to record the images produced by ground-based, long focal length, optical telescopes focused on missiles or other objects of interest at slant ranges of 100,000 to 700,000 feet. IRSLL will be an integral part of the Long Range Attitude and Event Instrumentation System (LORAE). To retain sufficient image size on the final recording medium, the anticipated telescopes will have focal lengths of 300 to 1,000 inches. Even with the envisioned telescope diameters of 18 to 40 inches, the light level at the telescope focal plane will be quite low. This low intensity and the fact that IRSLL frame rates will exceed 100 frames per second require some type of image intensification process within the IRSLL. Author (GRA)

N72-21670# Southern Methodist Univ., Dallas, Tex. Dept. of Statistics.
**SCATTERING OF SOUND FROM LAYERED HOLLOW ELASTIC CYLINDERS**
Joseph E. Tepera 8 Nov. 1971 79 p refs
(Contract N00014-68-A-0515; NR Proj. 042-260)
(AD-735859; TR-111) Avail: NTIS CSCL 20/1

The scattering of a continuous plane wave by a layered cylinder was investigated through the solution of hyperbolic wave equations and the associated boundary conditions. A basic steel cylinder was assumed to be coated with a single layer of an isotropic linearly elastic material, e.g., copper, nickel, etc., and the resulting far field scattered pressure patterns were computed considering fluid-filled interiors as well as boid interiors. Comparative analyses of the resulting patterns over a wave number range of 0.25 to 5.0 have shown that the mass and elastic moduli of the coating materials are of significant influence, and that there is the presence of an apparent transmission phenomenon. In addition, the thin shell solution to the scattering of a single layer cylinder resulted in magnitude differences in the forward scattered portion for radius-to-thickness (R/t) ratios up to 50 when compared to the 2-dimensional elasticity solution. Author (GRA)

N72-21671# Woods Hole Oceanographic Institution, Mass.
**DEEP TOWED HYDROPHONE ARRAY**
Willard Dow Dec. 1971 14 p refs
(Contract N00014-70-C-0205; NR Proj. 263-103)
(AD-735885; WHOI-Ref-71-70) Avail: NTIS CSCL 20/1

The report describes a new and simplified system for towing a hydrophone array at great depths from a surface vessel. When used in conjunction with deep fired explosives or other deep transitting sources, the array becomes an effective receiver for the long range deep echo ranging system thus formed. Two cruises have demonstrated the system to be effective for bottom survey work, and returns from targets over ranges up to 250 miles or more have been recorded. Author (GRA)

N72-21672# Radio Corp. of America, Lancaster, Pa. Electro-Optics Products.
**PHOTOMULTIPLIER TUBE FOR EFFICIENT INFRARED DETECTION Quarterly Progress Report, 22 Mar. - 21 Jun. 1971**
Dennis E. Persyk, Arthur F. McDonie, and Delbert D. Crawshaw Dec. 1971 25 p refs
(Contract DAAB07-70-C-0273)
(AD-735323; ECOM-0273-4; QPR-4) Avail: NTIS CSCL 17/5

The goal is to deliver a working 3/4 in diameter photomultiplier receiver that will outperform currently available S1 photocathode photomultipliers for laser ranging at 1.06 micrometers. Author (GRA)

N72-21673# Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
**[MICROWAVE TRANSMISSION AND INSTRUMENT RESEARCH] Progress Report, 15 Sep. 1970 - 14 Sep. 1971**
Arthur A. Oliner Nov. 1971 496 p refs
(Contract F44620-69-C-0047; AF Proj. 4751)
(AD-735366; PIBMRI-R-452.36.-71; PR-36; AFOSR-71-2695TR) Avail: NTIS CSCL 14/2

The report is compiled under six headings; Electromagnetics and Waveguide Techniques; Quantum Electronics and Optics; Plasma Physics and Energy Conversion; Solid State and Materials; Communications and Computers; Systems, Control, and Network Theory. Author (GRA)

N72-21674# California Univ., Los Angeles. Dept. of Mathematics.
**ON THE REFLECTION OF LIGHT FROM AN INHOMOGENEOUS SHELL**
Nicholaos G. Alexopoulos and Victor Barcilon 1972 11 p refs
(Contract N00014-69-A-0200-4022; Grant NSF GK-5433; NR Proj. 044-144)
(AD-736630) Avail: NTIS CSCL 20/14

The main contribution to the reflected field from a radially inhomogeneous spherical shell is determined. It is shown that it is much smaller in amplitude than the field reflected by a perfectly conducting sphere coated with the same type of radially inhomogeneous dielectric. Author (GRA)

N72-21708# Ford Motor Co., Dearborn, Mich. Scientific Lab.
**DENSITY OF STATES AND FERROMAGNETISM IN IRON**
K. J. Duff and T. P. Das (Utah Univ.) *In* NBS Electron. Density of States Dec. 1971 p 47-52 refs Sponsored by NSF (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

# 24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N72-21675*# California Univ., La Jolla. Dept. of Applied Physics and Information Science.
**NONCOMMUTING OBSERVABLES IN QUANTUM DETECTION AND ESTIMATION THEORY**
Carl W. Helstrom 10 Dec. 1971 8 p refs
(Grant NGR-05-009-079)
(NASA-CR-122364; Rept-71-02191) Avail: NTIS CSCL 20H

In quantum detection theory the optimum detection operators must commute; admitting simultaneous approximate measurement of noncommuting observables cannot yield a lower Bayes cost. The lower bounds on mean square errors of parameter estimates predicted by the quantum-mechanical Cramer-Rao inequality can also not be reduced by such means. Author

N72-21676*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**DISSOCIATIVE EXCITATION OF VACUUM ULTRAVIOLET EMISSION FEATURES BY ELECTRON IMPACT ON MOLECULAR GASES. 3: CO2**
M. J. Mumma, W. L. Borst (Southern Ill. Univ., Carbondale), and E. C. Zipf (Pittsburgh Univ., Pa.) Mar. 1972 37 p refs Submitted for publication
(Grant NGL-39-011-030; Contract DA-31-124-ARO/D-440)
(NASA-TM-X-65864; X-691-72-63) Avail: NTIS CSCL 20H

Vacuum ultraviolet multiplets of C I, C II, and O I were produced by electron impact on CO2. Absolute emission cross sections for these multiplets were measured from threshold to 350 eV. The electrostatically focused electron gun used is described in detail. The atomic multiplets which were produced by dissociative excitation of CO2 and the cross sections at 100 eV are presented. The dependence of the excitation functions on electron energy shows that these multiplets are produced by electric-dipole-allowed transitions in CO2. Author

N72-21677*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**A COMPUTER PROGRAM FOR MOESSBAUER DATA PROCESSING**
Lona M. Howser, Jag J. Singh, and Robert E. Smith, Jr. Washington Apr. 1972 63 p refs
(NASA-TM-X-2522; L-8176) Avail: NTIS CSCL 20H

A computer program to analyze Mossbauer data is presented in detail. The least-squares curve fitting techniques described apply to single line spectra, single hyperfine spectra, or when the constituent spectra are separated well enough to let the individual absorption peaks stand alone. The present program is not adapted for complex spectra resulting from the existence of several local environments in the absorber iron alloy. Sample problems are presented to aid the user in setting up and running the program. The program is written in FORTRAN 4 language for the Control Data 6000 series digital computer with the SCOPE 3.0 operating system and requires approximately 115,000 octal locations of core storage. A typical case with one absorption peak runs in 20 seconds, and a typical problem with six absorption peaks requires 50 seconds. Author

N72-21678# Pittsburgh Univ., Pa. Dept. of Physics.
**BEHAVIOR OF ELECTRON WAVE FUNCTIONS NEAR THE ATOMIC NUCLEUS AND NORMALIZATION SCREENING THEORY IN ATOMIC PHOTOEFFECT**
R. H. Pratt and H. K. Tseng Aug. 1971 39 p refs
(Contract AT(30-1)-3829)
(NYO-3829-75) Avail: NTIS

It is shown that point Coulomb shapes persist to quite large distances for bound states and also for energy-shifted continuum states. The screening effects on continuum state normalizations cancel the screening effects on the kinematic factor in matrix elements. These results were used to examine the normalization screening theory in atomic photoeffect. It is argued that this theory, which describes screening effects simply as a change in normalization, may be accurate to within 1% for photon energies more than 10 keV above the K shell threshold in Al, 30 keV in Cu, 60 keV in Sn, 150 keV in Pb, and 200 keV in U. This agrees in order of magnitude with exact numerical calculations. Author (NSA)

N72-21679# Kentucky Univ., Lexington. Dept. of Physics and Astronomy.
**RADIATION EFFECTS OF GERMANIUM**
B. R. Gossick Feb. 1971 8 p refs
(Contract AT(40-1)-3651)
(ORO-3651-10) Avail: NTIS

Studies were made of the influence of fast neutron bombardment on the transport properties of carriers in n-type Ge. An RF method was developed for measuring the ambipolar diffusion coefficient in intrinsic or near-intrinsic materials. NSA

N72-21680# Paris Univ., Orsay (France). Lab. de l'Accelerateur Lineaire.
**RESULTS OF THE ORSAY STORAGE RING ACO**
J. Lefrancois Nov. 1971 39 p refs Presented at Intern. Symp. on Electron and Photon Interactions, Ithaca, N. Y., 23-27 Aug. 1971
(LAL-1256; Conf-710816-2) Avail: AEC Depository Libraries

Positron and electron interactions were studied in the omega(0) and phi(0) meson regions at 990 MeV. Various branching ratios for the vector mesons were found. The pion(±)pion(-)pion(0) decay mode was used to calculate the omega(0) meson width and production cross section. The phi(0) meson width and production cross section were also found. The integrated luminosity and cross section was found for the event positron ± electron yields pion(±) ± pion(-) ± 2 pion(0) at 990 MeV. An experiment was performed on the interaction positron ± electron yields muon(±) ± muon(-) in the phi meson region. The cross section for the interaction was found, and a branching ratio for phi meson yields electron ± positron decay was determined. Evidence was found for hadronic vacuum polarization with a confidence level above 95%. NSA

N72-21681# European Organization for Nuclear Research, Geneva (Switzerland). Intersecting Storage Rings Div.
**COHERENT INSTABILITY DUE TO ELECTRONS IN**

**COASTING PROTON BEAM**
H. G. Hereward 27 Jul. 1971 7 p refs
(CERN-71-15) Avail: AEC Depository Libraries

The 40 to 60 MHz betatron mode signals that are seen in the intersecting storage rings and are at about the frequency of electrons oscillating in the potential well of the beam were studied. A model is described with which the thresholds and growth rates of instabilities arising from the interaction between the beam and the oscillating electrons can be estimated. NSA

**N72-21682#** Laboratoire Central de l'Armement, Arcueil (France).
**PRELIMINARIES TO EXTRACTING INFORMATION FROM DOSIMETRIC FILMS**
Jacques Vesque 28 Oct. 1970 23 p refs In FRENCH
(NP-19129) Avail: AEC Depository Libraries

The physical processes involved in the transformation of gamma ray energy into optical information on photographic emulsions were studied. The emulsions studied were envisaged for use in dosimetry. NSA

**N72-21683#** Rome Univ. (Italy). Inst. of Physics.
**SUBPROGRAMS FOR THE CALCULATION OF SPIN MATRIX ELEMENTS USING THE ZEMACH METHOD [SOTTOPROGRAMMI PER IL CALCOLO DEGLI ELEMENTI DI MATRICE DI SPIN SECONDO IL METODO DI ZEMACH]**
Mario Gaspero 13 Jul. 1971 20 p ref In ITALIAN
(Nota-Interna-328) Avail: NTIS

A Monte Carlo program, called OXALIS, was written for the UNIVAC 1108 computer to study the antiproton-neutron annihilation: antiproton + neutron yields 2 positive pions + 3 negative pions. The program includes a set of subroutines enabling the calculation of the spin matrix elements, in the Zemach relativistic form, using a few FORTRAN instructions. Two subroutines executing special Lorentz transformations are described and examples are given showing the use of OXALIS subroutines in the case where the angular momentum is larger than two. ESRO

**N72-21684#** Rome Univ. (Italy). Dept. of Physics.
**EXACT STATISTICAL-MECHANICAL TREATMENT OF A ONE-DIMENSIONAL QUANTAL MANY-BODY SYSTEM**
F. Calogero (Rome Univ.) Rome Univ. 6 Sep. 1971 11 p refs
(Nota-Interna-332) Avail: NTIS

The system consists of N1 particles of type 1 and N2 particles of type 2, (with N = N1 + N2 fixed and large). The particles of type S interact among themselves via a 2-body centrifugal potential. In addition all particles interact with an external oscillator potential that prevents them from escaping to infinity. The thermodynamic behavior of the macroscopic energy E and polarization M of the system as a function of the temperature is discussed. It is shown that depending on the nature of the particles of each type (identical or distinguishable), at zero temperature a phase transition does or does not occur. ESRO

**N72-21685#** Rome Univ. (Italy). Inst. of Physics.
**NUCLEAR CORE RENORMALIZATION. PART 1: COULOMB ENERGY DIFFERENCES**
P. Camiz, E. Olivieri, M. Scalia, and A. Dandrea 18 Nov. 1971 20 p refs
(Nota-Interna-344-Pt-1) Avail: NTIS

Core renormalization in light nuclei is introduced through core radius dependence on the occupation number of the last shell, in a linear approximation. The corresponding coefficient for the shells is obtained by fitting experimental Coulomb energy differences with a modified Hecht's mass formula, containing four adjustable parameters. Evidence is found for a renormalization effect corresponding to a dilatation of the core. Author (ESRO)

**N72-21686#** Rome Univ. (Italy). Inst. of Physics.
**EXPERIMENTS ON ELECTRON-POSITRON COLLIDING BEAMS**
M. Conversi 18 Nov. 1971 54 p refs Presented at the Second Study Week-End on Photon and Lepton Phys. in Europe, Daresbury, Engl., 1-3 Oct. 1971
(Nota-Interna-343) Avail: NTIS

The development of electron-positron storage rings in Europe is discussed together with experimental results, and future programs. The experiments performed with the machines include tests of quantum electrodynamics, vector mesons, and two-body and multibody hadronic events. ESRO

**N72-21687#** Rome Univ. (Italy). Inst. of Physics.
**ELEMENTARY PION WITH TRANSVERSE MOMENTUM CUT-OFF**
M. Lusignoli and Y. Srivastava 18 Nov. 1971 14 p refs Sponsored in part by NSF
(Nota-Interna-342) Avail: NTIS

Peaks in pion exchange processes are investigated and resolved in terms of an elementary pion with transverse momentum cut-off. In np CEX, for instance, this implies keeping both t and n channel pion exchanges. A quantitative fit is obtained for this process maintaining rho-A sub i exchange degeneracy. The quality of the fit is in general comparable with (if not better than) the strongly cut model with less than half the number of parameter. ESRO

**N72-21688#** Rome Univ. (Italy). Inst. of Physics.
**ANGULAR BEHAVIOUR OF THE K/PI RATIO AT HIGH ENERGY IN THE MULTI-REGGE MODEL**
C. Boldrighini and L. Lusanna (Florence Univ.) 4 Oct. 1971 14 p refs
(Nota-Interna-338) Avail: NTIS

The behavior of the K/Pi ratio in pp scattering as a function of mu = -log tan theta CM/2, at high energy is investigated using the Caneschi-Pignotti multi-Regge model. This behavior is practically independent of the trajectories exchange but is strongly dependent on the damping mechanisms for the perpendicular momenta of the outcoming secondaries. Good agreement with the existing cosmic ray data is found, and predictions are made that should easily be tested at NAL and ISR energies. ESRO

**N72-21689#** Rome Univ. (Italy). Inst. of Physics.
**MUON PAIR PRODUCTION BY ELECTRON POSITRON COLLISIONS IN THE GeV REGION**
G. Varbiellini (CNEN, Frascati, Italy), B. Borgia, F. Ceradini, M. Conversi, F. Grianti (Ist. Nazl. di Fis. Nucl., Genoa), M. Grilli (CNEN, Frascati, Italy), L. Paoluzi, R. Santonico, P. Spillantini (CNEN, Frascati, Italy), and R. Visentin (CNEN, Frascati, Italy) 29 Sep. 1971 15 p refs
(Nota-Interna-336) Avail: NTIS

The cross-section for electron-positron annihilation into muon pairs was measured at adone, simultaneously with that of wide angle Bhabha scattering (WAS), at total energies of the colliding beams up to 2.1 GeV. The results, based on a total of 400 annihilation events and 7192 associated WAS events, agree with the predictions of quantum electrodynamics and exclude the existence of a Lee-Wick heavy photon of mass smaller than 10 proton masses at 95% confidence level. Author (ESRO)

## 25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

**N72-21690*#** Iowa Univ., Iowa City. Dept. of Physics.
**PLASMA PHYSICS ABSTRACTS, 1 JANUARY 31 DECEMBER 1971**

David C. Montgomery and Donald A. Gurnett 31 Dec. 1971 14 p refs
(Grant NGL-16-001-043)
(NASA-CR-125979) Avail: NTIS CSCL 20I

Abstracts are presented on various aspects of plasma physics, including theoretical discussions and ionospheric plasmas. The topics considered cover Alfven waves, magnetized plasmas, plasma diffusion, Poynting flux measurements, electric fields, the magnetosphere, auroras, and plasma convection. K.P.D.

**N72-21691*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF THE COAXIAL PLASMA GUN FOR USE AS A PARTICLE ACCELERATOR**
Edward L. Shriver Washington Apr. 1972 78 p refs
(NASA-TN-D-6687) Avail: NTIS CSCL 20I

The coaxial plasma accelerator for use as a projectile accelerator is discussed. The accelerator is described physically and analytically by solution of circuit equations, and by solving for the magnetic pressures which are formed by the j cross B vector forces on the plasma. It is shown that the plasma density must be increased if the accelerator is to be used as a projectile accelerator. Three different approaches to increasing plasma density are discussed. When a magnetic field containment scheme was used to increase the plasma density, glass beads of 0.66 millimeter diameter were accelerated to 7 to 8 kilometers per second velocities. Glass beads of smaller diameter were accelerated to more than twice this velocity. Author

**N72-21692#** Nagoya Univ. (Japan). Inst. of Plasma Physics.
**OBSERVATION OF STABLE, HIGH-MACH-NUMBER COLLISIONLESS ELECTROSTATIC SHOCKS**
Tadao Honzawa Feb. 1972 20 p refs
(IPPJ-119) Avail: NTIS

Observation of large amplitude ion acoustic shocks with a high Mach number M > 1.6 in a collisionless plasma is described. Although they have large fluctuations behind the front, these shocks are close to the laminar rather than the turbulent ones, and they behave nonstationarily during propagation. Discussions about the nature and behavior of the shocks are also described. Author

**N72-21693*#** California Univ., Los Angeles.
**CONTINUOUS PLASMA LIGHT SOURCE** Patent Application
Willard F. Libby, Carl A. Jensen, and Lowell L. Wood, inventors (to NASA) Filed 10 Aug. 1971 39 p
(Grant NGR-05-007-003)
(NASA-Case-XNP-04167-3; US-Patent-Appl-SN-170544) Avail: NTIS CSCL 20I

A method and apparatus are described for producing intense, coherent, monochromatic light from a low temperature plasma. The apparatus includes a housing for confining a gas at subatmospheric pressure and including a set of reflectors defining an optical cavity. At least one anode and cathode are positioned within the gas. First control means control the voltage applied to the anode and second control means independently control the temperature of the cathode. The pressure of the gas is controlled by a third control means. An intense monochromatic output is achieved by confining the gas in the housing at a controlled, pre-determined reduced pressure, independently controlling the temperature of the electron emitting cathode and applying a predetermined controlled low voltage to the anode. NASA

**N72-21694#** Rouen Univ. (France). Faculte des Sciences.
**ELECTRIC CONDUCTIVITY PERPENDICULAR TO A MAGNETIC FIELD IN AIR AND NITROGEN PLASMAS IONIZED BY A SHOCK WAVE Ph.D. Thesis**
Marie-Joseph Cottereau 1970 144 p refs In FRENCH
(FRNC-TH-75) Avail: AEC Depository Libraries

Different calculational methods for determining the conductivity tensor of an ionized gas were analyzed. Particular attention was given to experimental results concerning shock wave ionized plasmas. A shock tube was used to obtain air or nitrogen plasmas and a four-electrode device was developed for making the measurements. The Joule effect in a molecular gas was studied. NSA

**N72-21695#** California Univ., Livermore. Lawrence Radiation Lab.
**ALTERNATING-DIRECTION IMPLICIT NUMERICAL SOLUTION OF TIME DEPENDENT, TWO-DIMENSIONAL, TWO FLUID MAGNETOHYDRODYNAMIC EQUATIONS**
Irvin R. Lindemuth 5 Aug. 1971 189 p refs
(Contract W-7405-eng-48)
(UCRL-51103) Avail: NTIS

The ADI method is applied to studies of the dynamics of a theta pinch and the trapping and thermalization of layer-produced plasma expanding into a magnetic field. For the theta pinch, the effect of heat flow parallel to the magnetic field and the effect of axial motion are demonstrated. For the laser-produced plasma, the formation and persistence of the high temperature shell observed in experiments is explained, and a bounce radius and time are predicted at which plasma motion across the magnetic field ceases. The calculations reported display strong two-dimensional phenomena which cannot be demonstrated by one-dimensional approaches. The implicitness of the method leads to enhanced numerical stability. The calculations were done with time steps much larger than permissible with codes using explicit finite difference equations, so that a significant reduction in computer time was obtained. Author (NSA)

**N72-21696#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**PLASMA DIAGNOSTIC SWIFT LASER BEAMS**
Janos Bito 23 Nov. 1971 31 p refs Transl. into ENGLISH from Muszaki Tudomany (Hungary), v. 43, no. 1/2, 1970 p 107-129
(AF Proj. 7073)
(AD-735480; FTD-HT-23-911-71) Avail: NTIS CSCL 20/9

The author gives a critical survey of the two characteristic groups of the plasma diagnostic methods with laser beams, that is to say, of the dispersion and interferometric measurements. He gives the basic connections, causing the dispersion phenomena, and also the calculation methods of the plasma characteristics on this basis. Starting from the basic connections of the measurements of the interferometric refractory index, carried out with neutral gases, he characterizes this method in the case of gases, in plasma state, ionized in different ways. He makes comparison between the spectral methods and the methods with laser beams and also characterizes the space and time resolution which can be gained by the latter method. Author (GRA)

**N72-21697#** General Research Corp., Santa Barbara, Calif.
**RADAR REFLECTION COEFFICIENTS FROM A PLASMA GRADIENT INCLUDING THE EFFECTS OF ELECTRON-NEUTRAL AND ELECTRON-ION COLLISIONS**
P. J. Redmond Sep. 1971 23 p refs
(Contract DASA01-70-C-0121)
(AD-735146; GRC-RM-1545; DNA-2786T) Avail: NTIS CSCL 20/9

An analytical expression is obtained for the radar reflection coefficient from a one-dimensional plasma. The formulation includes the effects of electron-neutral and electron-ion collisions and is applicable for either an exponential variation of the electron density with position or a variation of the form (n sub e)(x) - (n sub infinity)/(1 - e sup(-x/d)). Author (GRA)

**N72-21698#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**THE STUDY OF PLASMA FORMED BY ULTRASHORT LASER PULSES**
N. G. Basov, S. D. Zakharov, O. N. Kroklin, P. G. Kryukov, Yu. V.

Sensatskii, Ye. L. Tyurin, A. I. Fedosimov, S. V. Chekalin, and M. Ya. Shchelev 11 Nov. 1971 49 p refs Transl. into ENGLISH from Kvantovaya Elektron. (USSR), no. 1, 1971 21 p
(AD-736483; FTD-MT-24-987-71) Avail: NTIS CSCL 20/9

Processes occurring during high-temperature heating of plasmas have been studied experimentally by focusing laser emission of ultrashort duration on the surface of lithium deuteride. Experiments included the shadow photography of plasma with illumination by ultrashort pulses and the photo-registration of the dispersion of plasma with the aid of an image inverter, as well as the time dependence of laser pulse reflection and the measurement of the electron temperature of plasma with respect to its X-ray radiation. The basic processes which accompany the heating of plasma by ultrashort pulses are examined theoretically within the framework of approximations based upon the results of experiments. Author (GRA)

# 26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N72-21699 *National Lending Library for Science and Technology, Boston Spa (England).*

**A NEW METHOD OF INFRARED EXAMINATION OF ADSORPTION ON CLEAN METAL AND SEMICONDUCTOR SURFACES PRODUCED UNDER HIGH OR ULTRAHIGH VACUUM**

A. A. Babushkin and L. A. Mukhitdinov Feb. 1972 9 p refs Transl. into ENGLISH from Sb. Tr. Mosk. Inzh.-Stroit. Inst. (USSR), v. 58, 1968 p 12-24
(NLL-RTS-6710) Avail: Natl. Lending Library, Boston Spa, Engl.: £0.80; 3 NLL photocopy coupons

A method is described for IR spectroscopy of monomolecular layers of films produced on the surfaces of clean metals by the interaction of gases and vapors. The specifications of the spectroscopic equipment, and vacuum requirements are discussed along with absorption as a function of the angle of incidence.
F.O.S.

N72-21700 National Lending Library for Science and Technology, Boston Spa (England).

**DOUBLE INJECTION AND ELECTROLUMINESCENCE IN DOPED ANTHRACENE CRYSTALS**

H. P. Schwob and I. Zschokke-Granacher 5 Jan. 1972 21 p refs Trans. into ENGLISH from Mol. Crystals and Liquid Crystals, v. 13, 1971 p 115-136
(NLL-Trans-2818-(9022.81)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The current-voltage dependence and the current dependence of the electroluminescence at different wavelengths have been investigated in pure and in tetracene-doped anthracene crystals. The influence of traps is shown to be very significant. The current-voltage dependence is calculated by dividing the crystal in a hole-injecting region (density of electrons negligible) and in a space-charge-free region. The latter arises by emptying the traps by recombination; its thickness is proportional to the applied voltage. The temporal decay of the electroluminescence was measured after the contacts were shorted. The decay shows a fast component which had the fluorescence spectrum characteristic of tetracene, and a delayed component which had the fluorescence spectrum characteristic of anthracene. The delayed component is explained by assuming that each recombination, including free-trapped carrier recombination, has a high probability of yielding a triplet exciton. This will lead to delayed fluorescence by triplet-triplet annihilation. Analysis of the data shows free-trapped carrier recombination to be the dominant recombination mechanism. Author

N72-21701* National Aeronautics and Space Administration, Washington, D.C.

**SHIELDED CATHODE MODE BULK EFFECT DEVICES**
**Patent**

Frank R. Holmstrom, inventor (to NASA) Issued 19 Oct. 1971 5 p Filed 16 May 1968 Supersedes N69-33433 (07 - 19, p 3675)
(NASA-Case-ERC-10119; US-Patent-3,614,557; US-Patent-Appl-SN-825258; US-Patent-Class-317-235R; US-Patent-Class-317-234V; US-Patent-Class-331-107; US-Patent-Class-332-31; US-Patent-Class-307-299) Avail: US Patent Office CSCL 20L

Gunn effect microwave diodes are disclosed wherein that portion of the semiconductor material in which the direct current field is below the critical value for negative differential conductivity is shielded from applied radio frequency energy. High-conductance RF shielding is applied to the device in such a manner that applied RF fields interact only with the relatively short length portion of the semiconductor material in which the applied field is greater than the threshold for negative differential conductivity.
Official Gazette of the U.S. Patent Office

N72-21702# National Bureau of Standards, Washington, D.C.

**ELECTRONIC DENSITY OF STATES**

Lawrence H. Bennett, ed Dec. 1971 770 p refs Presented at the 3d Mater. Res. Symp., Gaithersburg, Md., 3-6 Nov. 1969
(NBS-SP-323) Avail: SOD $7.75 as C 13.10:323

Papers presented at the Third Materials Research Symposium of the National Bureau of Standards, held November 3-6, 1969 are reported. A review is provided of various experimental and theoretical techniques applied to the study of the electronic density of states in solids and liquids. The topics covered in a series of invited and contributed papers include theory of and experiments to obtain the one-electron density-of-state; many-body effects; optical properties; spectroscopic methods such as photoemission (X-ray and UV), ion neutralization, and soft X-ray; obtaining the density-of-states at the Fermi level by specific heat, magnetic susceptibility, and the Knight shift; the disordered systems of alloys, liquids, dirty semiconductors, and amorphous systems; and superconducting tunneling and the application of density of states to properties such as phase stability. An edited discussion follows many of the papers. For individual titles, see N72-21703 through N72-21797.

N72-21703# *Bristol Univ. (England). Wills (H. H.) Physics Lab.*

**THE BAND STRUCTURE PROBLEM**

J. M. Ziman *In* NBS Electron. Density of States Dec. 1971 p 1-12 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

By 1960 a number of practical methods were devised for the computation of electronic structure of ordered crystals. The first advance was to rewrite the OPW method in terms of pseudopotentials. Recently a rigorous analysis of the criteria for convergence of the various types of model potential or pseudopotential was developed. The next step was to show that the KKR (Green function) method could be expressed as a pseudopotential, and to demonstrate that this was a form of APW expansion. The connections between the band structure problem and the t-matrix theory of scattering were uncovered, and d-bands were seen to arise as resonances of the muffin-tin wells. The KKR matrix was now rewritten as a mixture of pseudopotential and tight-binding elements. Present techniques do not seem adequate for first-principles calculations on molecular crystals, where the anisotropy of the interstitial potential is probably the dominant feature. Little is known about disordered systems and nothing quantitatively. Author

N72-21704# Pratt and Whitney Aircraft, Middletown, Conn. Advanced Materials Research and Development Lab.

**ELECTRONIC DENSITIES OF STATES AND OPTICAL PROPERTIES OF CsCl TYPE INTERMETALLIC COMPOUNDS**

J. W. D. Connolly and K. H. Johnson *In* NBS Electron. Density

of States Dec. 1971 p 19-25 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The electronic band structures and densities of states have been calculated from first principles for two intermetallic compounds having the CsCl structure. The nonrelativistic augmented plane wave method has been used in conjunction with an LCAO interpolation technique to determine the band structure and density of states of beta prime NiAl to a high degree of accuracy. These theoretical results are in excellent agreement with the measured optical properties if k-conserving (direct) interband transitions are assumed to be dominant. A similar study has been carried out for beta prime AuZn, using as a basis the energy bands determined by the relativistic Korringa-Kohn-Rostoker method. The band profiles and density of states of beta prime AuZn are qualitatively similar to those of beta prime NiAl, except for the appearance of relativistic effects in the former alloy and differences in the relative positions and widths of the respective Au and Ni d-bands. The beta prime AuZn results have also been compared with the measured optical properties and are again consistent with these measurements if direct interband transitions are assumed.
Author

**N72-21705#** Pratt and Whitney Aircraft, Middletown, Conn. Advanced Materials Research and Development Lab.
**THE CALCULATION OF DENSITIES OF STATES BY LCAO INTERPOLATION OF ENERGY BANDS WITH APPLICATION TO IRON AND CHROMIUM**
J. W. D. Connolly *In* NBS Electron. Density of States Dec. 1971 p 27-32 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The LCAO (linear combination of atomic orbitals) interpolation method is described as a means of calculating the density of states curves of a crystalline solid. This method is shown to be more straightforward and convenient to use than the composite (LCAO-OPW) techniques that have recently been proposed for transition metals. A computer program is described which determines the LCAO interaction integrals from an ab initio energy band calculation by a nonlinear least squares procedure, and then uses these parameters to sample the Brillouin zone at a large number of points in order to calculate the density of states curve to a high degree of accuracy. As examples of the application of this program, the results of calculations on chromium (in both the nonmagnetic and antiferromagnetic states) and iron (nonmagnetic and ferromagnetic) are presented and compared with the recent photoemission data. Author

**N72-21706#** Lincoln Lab., Mass. Inst. of Tech., Lexington. c17
**OPTICAL PROPERTIES OF ALUMINUM**
G. Dresselhaus, M. S. Dresselhaus, and D. Beaglehole (Maryland Univ.) *In* NBS Electron. Density of States Dec. 1971 p 33-36 refs Sponsored by the AF (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The Ashcroft energy band model which provides a good representation of the measured Fermi surface of aluminum is used here to calculate the optical properties. New reflectivity measurements in aluminum have also been carried out between 2 microns and 3000 A using a sensitive continuous frequency scanning technique. A Kramers-Kronig analysis of the reflectivity data yields a frequency dependent dielectric constant which is essentially in agreement with the results of the calculation. This comparison suggests that the optical properties of aluminum can be described in terms of a one-electron energy band model.
Author

**N72-21707#** Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
**ON THE OPTICAL PROPERTIES AND THE DENSITY OF STATES IN ARSENIC** c18
R. W. Brodersen and M. S. Dresselhaus *In* NBS Electron. Density of States Dec. 1971 p 39-44 refs (See N72-21702 12-26)
(Contract ARPA SD-90)
Avail: SOD $7.75 as C 13.10:323

The infrared reflectivity of arsenic is calculated and correlated with Fermi surface, magnetoreflection and optical reflectivity measurements. These infrared properties are strongly affected by interband transition for light incident along the trigonal direction is due to the simultaneous occurrence of a strong interband momentum matrix element and a large density of states. By considering this interband transition explicitly, good agreement is obtained with the experimental data of Riccius. Author

**N72-21708#** Ford Motor Co., Dearborn, Mich. Scientific Lab.
**DENSITY OF STATES AND FERROMAGNETISM IN IRON** c23
K. J. Duff and T. P. Das (Utah Univ.) *In* NBS Electron. Density of States Dec. 1971 p 47-52 refs Sponsored by NSF (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The band structure of ferromagnetic iron has been calculated by a variational method using a basis of tight-binding functions and orthogonalized plane waves. Exchange matrix elements are evaluated without approximation by a local potential. Correlation effects are explicitly included. Histograms for the density of states are constructed and compared with photoemission and optical reflection and X-ray emission data. The calculation leads self-consistently to the observed magnetic moment. The relative importance of intra-atomic exchange and itinerancy to the origin of iron's ferromagnetism is discussed. Author

**N72-21709#** California Univ., Los Angeles. Dept. of Electrical Sciences and Engineering.
**CALCULATION OF DENSITY OF STATES IN W, Ta, AND Mo**
I. Petroff and C. R. Viswanathan *In* NBS Electron. Density of States Dec. 1971 p 53-56 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

Density of states curves were calculated for tungsten, tantalum and molybdenum from corresponding energy band structures obtained by a nonrelativistic APW calculation. The Fermi energy and the density of states at the Fermi energy were obtained for each material. The calculations were part of a study intended to calculate theoretical photoemission yield curves which could be compared with experimental results. Author

**N72-21710#** Oak Ridge National Lab., Tenn. Metals and Ceramics and Solid State Div.
**ADJUSTMENT OF CALCULATED BAND STRUCTURES FOR CALCIUM BY USE OF LOW TEMPERATURE SPECIFIC HEAT DATA**
R. W. Williams and H. L. Davis *In* NBS Electron. Density of States Dec. 1971 p 57-61 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The electronic band structure of calcium has been studied theoretically by employing the Korringa-Kohn-Rosteker method. The crystal potentials used in our calculation were obtained by means of a standard superposition of free-atom charge densities. E sub k vs k curves and the density of states at the Fermi energy were calculated for various potentials, with the measured low-temperature electronic specific heat coefficient (gamma) being used as an empirical aid to adjust the exchange portion of the crystal potential. The important feature of the potentials used is that they all give band structures which have definite d-band character in the vicinity of the Fermi surface. These d bands or their corresponding d scattering resonances vary rapidly in energy for small changes in the exchange, resulting in values of gamma which are extremely sensitive to exchange. Author

**N72-21711#** Sandia Labs., Albuquerque, N.Mex.
**FERMI SURFACE PROPERTIES OF THE NOBLE METALS AT NORMAL VOLUME AND AS A FUNCTION OF PRESSURE**
W. J. OSullivan, A. C. Switendick, and J. E. Schirber *In* NBS Electron. Density of States Dec. 1971 P 63-65 refs (See

N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The results are presented of nonrelativistic KKR calculations of the Fermi surface properties of Cu, Ag, and Au at normal volume and as a function of pressure. In particular electronic specific heats, effective masses and the associated pressure shifts are compared with the corresponding experimental results for the noble metals. In contrast to the results of previous calculations it is found that the Herman-Skillman-Mattheiss crystal potential is an excellent potential for both Cu and Ag.
Author

**N72-21712#** Los Alamos Scientific Lab., N.Mex.
**CALCULATED EFFECTS OF COMPRESSION UPON THE BAND STRUCTURE AND DENSITY OF STATES OF SEVERAL METALS**
E. A. Kmetko *In* NBS Electron. Density of States Dec. 1971 p 67-73 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

Energy bands were obtained self-consistently by the augmented plane wave method for the following metals: Li, Cs, Ca, Sr, Ba, La, Ce, U. Pu. W and Fe. The density of states and the electronic change were resolved into s-, p-, d-, and f-like components. Under compression the changes associated with the higher values of l increase, mainly at the expense of the s-like component, and a more compact overall distribution is thereby achieved. The present results indicate that such electronic transitions are of general occurrence and probably play a significant role in determining the compressibility of metals.
Author

**N72-21713#** Brown Univ., Providence, R.I.
**OPTICAL PROPERTIES AND ELECTRONIC DENSITY OF STATES**
M. Cardona (Deutsches Elektronen-Synchrotron) *In* NBS Electron. Density of States Dec. 1971 p 77-89 refs Supported by NSF and the Army (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The fundamental absorption spectrum of a solid yields information about critical points in the optical density of states. This information can be used to adjust parameters of the band structure. Once the adjusted band structure is known, the optical properties and the density of states can be generated by numerical integration. The parametrization techniques used for obtaining band structures suitable for density of states calculations are reviewed. The calculated optical constants are compared with experimental results. The energy derivative of these optical constants is discussed in connection with results of modulated reflectance measurements. It is also shown that information about density of empty states can be obtained from optical experiments involving excitation from deep core levels to the conduction band. A detailed comparison of the calculated one-electron optical line shapes with experiment reveals deviations which can be interpreted as exciton effects. The accumulating experimental evidence pointing in this direction is reviewed together with the existing theory of these effects. A number of simple models for the complicated interband density of states of an insulator have been proposed. The Penn model, which can be used to account for response functions at zero frequency, and the parabolic model, which can be used to account for the dispersion of response functions in the immediate vicinity of the fundamental absorption edge are discussed.
Author

**N72-21714#** Aerospace Research Labs., Wright-Patterson AFB, Ohio.
**THEORETICAL ELECTRON DENSITY OF STATES STUDY OF TETRAHEDRALLY BONDED SEMICONDUCTORS**
D. J. Stukel, T. C. Collins, and R. N. Euwema *In* NBS Electron. Density of States Dec. 1971 p 93-102 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The electron density of states has been calculated using a self-consistent orthogonalized plane wave model for compounds in the isoelectronic sequences Si-AlP and Ge-GaAs-ZnSe. The valence and conduction band density of states are presented. The location of the core states is also given. The effect upon the density of states of using the exchange approximations of Slater, Kohn-Sham, and Liberman is displayed.
Author

**N72-21715#** National Research Council of Canada, Ottawa (Ontario). Div. of Physics.
**ELECTRONIC DENSITY OF STATES IN EU-CHALCOGENIDES**
S. J. Cho *In* NBS Electron. Denisty of States Dec. 1971 p 105-108 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The spin-polarized energy bands and the electronic density of states in the Eu-chalcogenides have been obtained by the augmented-plane-wave method. The results show that the f bands are extremely sensitive to the exchange potential used, and f bands become the highest valence bands with a band width of the order of 0.5 eV. Our results have been compared with the recent photoemission spectroscopy data. The UPS data show too large f band width and too small relative peak intensities of the f bands, which disagree with our results. The 4f bands in the Eu and Gd could be located within 3.0 eV below their Fermi energies.
Author

**N72-21716#** General Motors Research Labs., Warren, Mich.
**ENERGY BAND STRUCTURE AND DENSITY OF STATES IN TETRAGONAL GeO2**
F. J. Arlinghaus and W. A. Albers, Jr. *In* NBS Electron. Density of States Dec. 1971 p 111-113 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The electronic energy bands of tetragonal GeO2 have been calculated and correlated with optical properties of single crystals of this material. The agreement between theory and experiment is sufficiently good to warrant calculations of densities of states and conduction band effective masses preparatory to the determination of the dielectric constant as a function of energy. The calculated energy bands density of states, and the experimental optical absorption edge data are presented and discussed.
Author

**N72-21717#** Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
**CALCULATION OF THE DENSITY OF STATES AND OPTICAL PROPERTIES OF PbTbTe FROM APW-LCAO ENERGY BANDS**
D. D. Buss and V. E. Schirf *In* NBS Electron. Density of States Dec. 1971 p 115-123 refs Supported by NSF and the Army (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The overlap integrals in the tight-binding secular equation for the relavistic p-bands in PbTe have been adjusted to give the best representation of the APW results at high symmetry points. The resulting LCAO bands have been used to calculate the density of states in energy and the optical constants of PbTe. The calculated density of states is found to have peaks which correspond closely to the four peaks measured by Spicer and Lapeyre. However, the assignment of peaks to bands is found to be different from that proposed previously. The method of Dresselhaus and Dresselhaus has been used to obtain the oscillator strengths for optical transitions, and these are found to agree with previous calculations. The interband electronic contribtuion to the optical constants has been calculated for photon energy less than 5 eV.
Author

**N72-21718#** Chalmers Univ. of Technology, Goteborg (Sweden).
**PLASMON-INDUCED STRUCTURE IN THE OPTICAL INTERBAND ABSORPTION OF FREE ELECTRON-LIKE METALS**
B. I. Lundqvist and C. Lyden *In* NBS Electron. Density of States Dec. 1971 p 125-127 refs (See N72-21702 12-26)

Avail: SOD $7.75 as C 13.10:323

Butcher's method was extended to include the spectrum of interacting electrons which contain satellite structure. The calculated optical conductivity shows a weak additional absorption, starting at the frequency omega sub t + omega sub p, where omega sub p is the interband threshold frequency and omega sub p the plasma frequency. Author

N72-21719# Cornell Univ., Ithaca, N.Y. Lab. of Atomic and Solid State Physics.

**THEORY OF THE PHOTOELECTRIC EFFECT AND ITS RELATION TO THE BAND STRUCTURE OF METALS**

N. W. Ashcroft and W. L. Schaich *In* NBS Electron. Density of States Dec. 1971 p 129-134 refs (See N72-21702 12-26) (Grant NSF 7198)

Avail: SOD $7.75 as C 13.10:323

The theory of the external photoelectric effect is developed in terms of quadratic response to the incident electromagnetic field. Electrons in the solid are in states determined by their interactions with themselves, the ions and the surface. A careful examination of the terms appearing in the photoelectric current shows that it is not always correct to interpret photoemission in terms of a volume effect or a surface effect. The contributions from these two interfere. The usual explanations of the processes involved (i.e., the sequential operations of excitation, transport, and transmission) are also somewhat blurred. The effect of electron-electron scattering is well known to be important and is discussed both in terms of its manifestation in the observed electron distribution curves and its ability to limit the contribution of the conventional volume effect. Author

N72-21720*# Stanford Univ., Calif. Electronic Lab.

**OPTICAL DENSITY OF STATES ULTRAVIOLET PHOTOELECTRIC SPECTROSCOPY**

W. E. Spicer *In* NBS Electron. Density of States Dec. 1971 p 139-158 refs Sponsred in part by NASA, NSF, AROD, ARPA, and Army Night Vision Labs. (See N72-21702 12-26) (NASA-CR-126040) Avail: NTIS; SOD $7.75 as C 13.10:323 CSCL 20L

The use of ultraviolet photoemission to determine the density of valence and conduction states is reviewed. Two approaches are recognized. In one, the photoemission as well as other studies are used to locate experimentally a limited number of features of the band structure. Once these are fixed, band structure calculations could be carried out throughout the zone and checked against other features of the photoemission data. If the agreement is sufficiently good, the density of states is then calculated from the band structure. The second method depends only on experimental data. Features of the density of states are determined directly by the photoemission experiment without recourse to band calculations. In cases where bands are wide and k clearly provides an empirically important optical selection rule, this is possible only for portions of the bands which are relatively flat. Successful determinations of this type are cited for PbTe, and GaAs. In metals with narrow d bands such as Cu, it has been found empirically that one may explain fairly well the experimental energy distribution curves in terms of transitions between a density of initial and final states (the optical density of states, ODS) requiring only conservation of energy. The ODS determined by such ultraviolet photoemission studies have more strong detailed structure than the density of states determined by any other experimental method. Studies on a large number of materials indicate that the position in energy of this structure correlates rather well with the position in energy of structure in the calculated density of states. Author

N72-21721# Stanford Univ., Calif.

**THE DENSITY OF STATES AND PHOTOEMISSION FROM INDIUM AND ALUMINUM**

R. Y. Koyama and W. E. Spicer *In* NBS Electron. Density of States Dec. 1971 p 159-161 refs (See N72-21702 12-26) (Contract DA-44-009-AMC-1474(7))

Avail: SOD $7.75 as C 13.10:323

Experimental photoemission data from indium and aluminum are briefly described and can be understood in terms of a density of states model. In contrast to this, a direct transition model based on calculated band structures is found to yield photoelectron spectra which are fair reproductions of the density of states. This suggests that for these two metals, conclusions drawn concerning the density of states are independent of the model used to explain the photoemission data. Author

N72-21722# California Univ., Berkeley. Lawrence Radiation Lab.

**ELECTRONIC DENSITIES OF STATES FROM X-RAY PHOTOELECTRON SPECTROSCOPY**

C. S. Fadley and D. A. Shirley *In* NBS Electron. Density of States Dec. 1971 p 163-178 refs (See N72-21702 12-26)

Avail: SOD $7.75 as C 13.10:323

X-ray photoelectron spectroscopy was used to study the densities of states of the metals Fe, Co, Ni, Cu, Ru, Rh, Pd, Ag, Os, Ir, Pt, and Au, and also the compounds ZnS, CdCl2, and HgO. The d bands of these solids are observed to have systematic behavior with changes in atomic number, and to agree qualitatively with the results of theory and other experiments. A rigid band model is found to work reasonably well for Ir, Pt and Au. The d bands of Ag, Ir, Pt, Au and HgO are found to have a similar two-component shape. Author

N72-21723# International Business Machines Corp., Yorktown Heights, N.Y. Watson (Thomas J.) Research Center.

**DIRECT TRANSITION ANALYSIS OF PHOTOEMISSION FROM PALLADIUM**

J. F. Janak, D. E. Eastman, and A. R. Williams *In* NBS Electron. Density of States Dec. 1971 p 181-189 refs (See N72-21702 12-26)

Avail: SOD $7.75 as C 13.10:323

The energy distribution of optically excited electrons in Pd arising from direct interband transitions has been calculated assuming constant momentum matrix elements. Principal features of new photoemission data (d-band structure with four peaks at 0.15, 1.2, 2.2, and 3.5 eV below the Fermi level and a d-band width of approximately 3.8 eV) are successfully explained by these calculations. The data can be analyzed with comparable success using the nondirect-transition model, but only by assuming a free-electron density of unoccupied states, which is shown to be unjustified for Pd. In addition to the photoemission spectra and the density of states, the imaginary part of the dielectric constant is computed and compared with experiment. Author

N72-21724# Bell Telephone Labs., Inc., Murray Hill, N.J.

**PHOTOEMISSION DETERMINATION OF THE ENERGY DISTRIBUTION OF THE JOINT DENSITY OF STATES IN COPPER**

N. V. Smith *In* NBS Electron. Density of States Dec. 1971 p 191-197 refs (See N72-21702 12-26)

Avail: SOD $7.75 as C 13.10:323

Measurements have been made of the photoemission properties of cesiated copper, with improved sample preparation over the previous work by Berglund and Spicer. The energy distribution curves (ECDs) of photoemitted electrons show structure in the region associated with the copper d bands which was not seen in the previous data. The behavior in the photon energy range 6 to 8 eV is particularly interesting in that some of these new peaks in the EDCs are observed to move, appear and disappear in a manner characteristic of direct transitions. Parallel calculations have been performed of the energy distribution of the joint density of states (EDJDOS) similar to those reported recently by Smith and Spicer. The band structure used was the interpolation scheme of Hodges, Ehrenreich, and Lang fitted to the APW calculation of Burdick. In a constant matrix element approximation, the EDJDOS represents the energy distribution of photoexcited electrons. This was converted to an energy distribution of photoemitted electrons by introducing appropriate threshold and escape factors. The overall agreement with

experiment is good. It was found that the optical transitions from parts of the copper d bands can be identified as direct. It was also found that the most persistent peaks in the calculated EDJDOS tend to coincide with the peaks in the calculated true density of states. This indicates that when a phenomenological optical density of states can be obtained, it may well be a good approximation to the true density of states even if transitions are direct. Author

**N72-21725#** Naval Electronics Lab. Center, San Diego, Calif.
**THE BAND STRUCTURE OF TUNGSTEN AS DETERMINED BY ULTRAVIOLET PHOTOELECTRIC SPECTROSCOPY**
C. R. Zeisse *In* NBS Electron. Density of States Dec. 1971 p 199-203 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The technique of photoelectron spectroscopy has been used to probe the band structure of tungsten in the energy region where the 5d bands are most prominent. The work function of the clean sample, a 25 micron thick polycrystalline foil, was found to be 4.36 + or - 0.02 eV, and the yield rose by three orders of magnitude from 5.0 to 11.3 eV without showing prominent structure of any other stort. The electron energy spectra, on the other hand, contain two pieces of reliable structure which are found to increase in energy at the same rate as the exciting photon energy. A simple analysis of the data gives evidence that the density of d states in tungsten consists of a shoulder just below the Fermi level, a peak located about 1.5 eV below the shoulder, and a broad peak which extends at least 7eV below the Fermi level. Author

**N72-21726#** International Business Machines Corp., Yorktown Heights, N.Y. Watson (Thomas J.) Research Center.
**PHOTOEMISSION STUDIES OF SCANDIUM, TITANITUM, AND ZIRCONIUM**
D. E. Eastman IN NBS Electron. Density of States Dec. 1971 p 205-208 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

Photoemission spectroscopy studies of the hexagonal metals Sc, Ti and Zr in the 4 to 11.6 eV range have resolved d-band structure and have determined occupied d-band widths (at 1/2 maximum) to 1.6, 2.0 and 2.3 eV respectively. Resolved structure for all three metals correlates with structure in energy band density of states: however, the observed band widths for Ti and Zr are much narrower than previously calculated band widths. The relation of the data to the controversy concerning the nature of optical excitations in transition and noble metals (direct vs nondirect transitions) is discussed. Author

**N72-21727*#** Montana State Univ., Bozeman. Dept. of Physics.
**PHOTOEMISSION AND REFLECTANCE STUDIES OF THE ELECTRONIC STRUCTURE OF MOLYBDENUM**
K. A. Kress and G. J. Lapeyre *In* NBS Electron. Density of States Dec. 1971 p 209-215 refs Sponsored in part by NASA (See N72-21702 12-26)
(Grants AF-AFOSR-838-65; AF-AFOSR-1450-68)
(NASA-CR-126041) Avail: NTIS; SOD $7.75 as C 13.10:323 CSCL 20L

Photoemission and optical measurements were used to study the electronic structure of the 4d metal molybdenum. The photoemission data were found to be consistent with the nondirect model with one possible exception. Because of the essentially nondirect character of the photoemission data, an optical density of states (ODS) graph was constructed. The results are compared with band calculation of molybdenum's 5d counterpart tungsten and its 3d counterpart chromium. Author

**N72-21728#** Chalmers Univ. of Technology, Goteborg (Sweden). Dept. of Physics.
**ULTRAVIOLET AND X-RAY PHOTOEMISSION FROM EUROPIUM AND BARIUM**
G. Broden, S. B. M. Hagstroem, P. O. Heden, and C. Norris *In* NBS Electron. Density of States Dec. 1971 p 217-226 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

Europium and barium are predicted to have very similar outer electronic structures with the exception that europium has a partially filled 4f shell. Measurements are reported on photoemission from thin films excited with both vacuum ultraviolet and soft X-ray radiation. The results obtained using the low energy excitation indicate the similarity of the materials. Both show structure close to the leading edge in agreement with band structure calculations which indicate an increase in the density of states immediately below the Fermi level. Only a very small feature is observed with europium films which can be associated with the 4f electrons. On the other hand using soft X-ray excitation a large peak corresponding to 4f states lying 2.5 eV below the Fermi level is observed. The difference in the magnitudes is attributed to the size of the matrix elements involved. Author

**N72-21729#** Pennsylvania Univ., Philadelphia. Dept. of Physics.
**WHAT IS A QUASI-PARTICLE?**
J. R. Schrieffer *In* NBS Electron. Density of States Dec. 1971 p 227-231 refs Sponsored in part by NSF (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The concept of a quasi-particle excitation in an interacting many-body system is discussed from both the physical and the mathematical points of view. The physical origin of mass enhancement, wave function renormalization, and interactions between quasi-particles, will be presented. Landau's Fermi liquid theory, including the quasi-particle, kinetic equation, is reviewed. Finally, the domain of validity of the quasi-particle approximation is discussed. Author

**N72-21730#** Chalmers Univ. of Technology, Goteborg (Sweden).
**BEYOND THE ONE ELECTRON APPROXIMATION: DENSITY OF STATES FOR INTERACTING ELECTRONS**
L. Hedin, B. I. Lundqvist, and S. Lundqvist *In* NBS Electron. Density of States Dec. 1971 p 233-247 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The excitation process in which one electron is added or removed from a solid is defined. The one particle spectral function for conduction and core electrons in metals is discussed. The calculation of the one particle spectral function and the relationship to X-ray photoemission, X-ray emission and absorption, photoemission, and optical absorption in the ultraviolet are presented. The form of the exchange correlation potential for use in band structure calculations is examined. Author

**N72-21731#** Oregon Univ., Eugene. Inst. of Theoretical Science.
**EXCITONIC EFFECTS IN X-RAY TRANSITIONS IN METALS**
G. D. Mahan *In* NBS Electron. Density of States Dec. 1971 p 253-258 refs Sponsored by NSF Presented in cooperation with GE Co., Schenectady, N. Y. (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The use of soft X-ray transitions in solids as a direct measure of the density of the states is discussed. The errors introduced by assuming that matrix element variations over the band and that final state interactions are small are described. Two approximate calculations are presented: (1) electron oscillator strength of simple bcc metal as a function of energy and (2) the strength of the singularity at threshold, with phase shifts estimated from an assumed interaction between core electrons and core hole. Author

**N72-21732#** Michigan Univ., Ann Arbor. Dept. of Chemistry.
**VIBRONIC EXCITATION DENSITY OF STATES IN SOME MOLECULAR CRYSTALS**
R. Kopelman and J. C. Laufer *In* NBS Electron. Density of

States Dec. 1971 p 261-267 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The description of excited states of molecular crystals using the Frenkl model is discussed. A special case of the Frenkl model, one with steeply falling-off intersite interactions is presented. The expression for the band structure in this model depends only on the interchange symmetry of the crystal, with a small number of intersite parameters. Examples are given for some aromatic crystals, comparing band structures derived from theoretically calculated parameters, experimentally derived parameters, and completely experimentally band structure.
Author

**N72-21733#** Chalmers Univ. of Technology, Goteborg (Sweden).
**EFFECT OF THE CORE HOLE ON SOFT X-RAY EMISSION IN METALS**
L. Hedin and R. Sjoestroem *In* NBS Electron. Density of States Dec. 1971 p 269-270 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

A numerical method for estimating the enhancement factor on the intensity of soft X-ray emission in free-electron like metals due to the effect of the core hole is presented. An electron gas in the presence of a perturbing potential is considered. The X-ray intensity is calculated assuming the dipole matrix elements to be constant. The calculation is based on a simple type of trial function for the initial state of the valence electron system and the coefficients are determined from the variation principle. The enhancement factor is found to vary roughly linearly over the main band, increasing about 50 percent in going from the bottom of the band to the Fermi edge.
Author

**N72-21734#** Bristol Univ. (England).
**CANCELLATION EFFECTS IN THE EMISSION AND ABSORPTION SPECTRA OF LIGHT METALS**
B. Bergersen (Inst. of Theoretical Phys.) and F. Brouers *In* NBS Electron. Density of States Dec. 1971 p 273-274 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

Two observed features of X-ray spectra which cannot be explained by a one electron theory are discussed. The first feature is the low energy tailing of the emission bands superposed by a weak plasmon satellite band. The second feature is the effect if core hole sudden switching which causes anomalous behavior near the emission and absorption Fermi edges. A number of formal and numerical results to correct previous calculations and a theory for the entire band of emission and absorption spectra of light metals are presented.
Author

**N72-21735#** Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
**PHOTOABSORPTION MEASUREMENT OF Li, Be, Na, Mg, AND Al IN THE VICINITY OF K AND L(II, III) EDGES**
C. Kunz, R. Haensel, G. Keitel, P. Schreiber, and B. Sonntag *In* NBS Electron. Density of States Dec. 1971 p 275-277 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The absorption structure of five light metals has been measured in the vicinity of the onset of K shell respectively L sub II,III shell absorption. In accord with recent theoretical investigations as peaking of the cross section at the edge is observed for L sub 2,3 edges of Na, Mg, and less pronounced for Al. There is structure of a different type at the K edges of Li and Be.
Author

**N72-21736#** Bell Telephone Labs., Inc., Murray Hill, N.J.
**THE PIEZO SOFT X-RAY EFFECT**
R. H. Willens *In* NBS Electron. Density of States Dec. 1971 p 281-285 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The modulation of the L sub III emission band of polycrystalline copper by an alternating elastic strain has recently been measured. Two effects are observed. First, there is an overall band shift which gives a measure of the deformation potentials. The band shift is not uniform as different sub-bands can shift varying degrees. For an applied load of 12,000 psi in uniaxial tension, the shift of the high energy side of the band is 0.015 eV and the low energy side is 0.010 eV. Because of the preferred orientation and polycrystalline nature of the sample, the exact microscopic sample is isotropic with a Young's modulus of 20 x one million psi, the average deformation potential is 25 eV at the top of the band and 17 eV at the bottom of the band. Secondly, superimposed on this band shift is structure which is unresolved in the normal emission spectrum. The origin of this structure is presumed to be from positions in the electronic structure which are extra sensitive to strain as far as altering the X-ray emission. This would be at Van Hove singularities or critical points where a high degree of degeneracy and wave function mixing is prevalent which can be changed by the symmetry alteration of the lattice due to strain. Comparison between the theoretical band structure calculations of copper and the emission structure due to strain modulation show several similarities.
Author

**N72-21737#** Strathclyde Univ., Glasgow (Scotland). Dept. of Metallurgy.
**SOFT X-RAY BAND SPECTRA AND THEIR RELATIONSHIPS TO THE DENSITY OF STATES**
G. A. Rooke *In* NBS Electron. Density of States Dec. 1971 p 287-293 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The similarities and differences between the one electron spectrum and the density of states are presented. Many-body effects are listed, but not considered in detail. It is shown that the only reliable information about the density of states that can be obtained from soft X-ray spectroscopy are the energies of the Fermi surface and the Van Hove singularities. Examples are presented to illustrate the differences between the density of states and the one electron spectra. The soft X-ray spectra from the aluminum-magnesium system is presented to illustrate application of the technique to the study of alloys.
Author

**N72-21738#** Sandia Labs., Albuquerque, N.Mex.
**ORBITAL SYMMETRY CONTRIBUTIONS TO ELECTRONIC DENSITY OF STATES OF AuAl**
A. C. Switendick *In* NBS Electron. Density of States Dec. 1971 p 297-301 refs Sponsored by AEC (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

Density of states histograms for AuAl2 were constructed from an augmented plane wave calculation of the valence and conduction bands. The partitioning of the total density of states into atomic-like components according to the fractional atom-like character of each state is discussed. Comparison of the low energy peak with the absolute location and location relative to the Fermi energy is made to confirm the overall correctness of the method.
Author

**N72-21739#** National Bureau of Standards, Washington, D.C. Inst. for Materials Research.
**SOFT X-RAY EMISSION SPECTRUM OF Al IN AuAl2**
M. L. Williams, R. C. Dobbyn, J. R. Cuthill, and A. J. McAlister *In its* Electron. Density of States Dec. 1971 p 303-305 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The measurement of the L sub 2,3 emission spectrum of aluminum in AuAl2 is reported. Based on this measurement, the AlLsub 3 emission profile was estimated and later compared with s-orbital state density at Al sites. This s density is considered the dominent factor in a one electron estimate of the soft X-ray emission rate.
Author

**N72-21740#** Strathclyde Univ., Glasgow (Scotland). Dept. of Metallurgy.
**SOFT X-RAY EMISSION FROM ALLOYS OF ALUMINUM**

**WITH SILVER, COPPER, AND ZINC**
D. J. Fabian, G. Mc. D. Lindsay, and L. M. Watson *In* NBS Electron. Density of States Dec. 1971 p 307-312 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

Measurements of the soft X-ray emission from the alloys Al-Ag, Al-Cu and Al-Zn are reported, and the effect of the d-bands of the metals Ag, Cu and Zn on the Al L sub 2,3-emission for these alloys is examined. For Al-Ag and Al-Cu alloys, sharp resonance peaks are observed in the Al L sub 2,3-spectra and are attributed to transitions from states in the hybridized silver and copper d-bands to core states of the aluminums atoms. The observations agree with the general theoretical considerations, for a simple metal alloyed with a noble metal. For the Al-Zn alloys the d-bands of Zn do not contribute to the Al L sub 2,3-emission. Author

**N72-21741#** Ludwig-Maximilians-Universitat, Munich (West Germany). Sektion Physik.
**SOFT X-RAY EMISSION SPECTRA OF Al-Mg ALLOYS**
H. Neddermeyer *In* NBS Electron. Density of States Dec. 1971 p 313-317 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The measurement of the soft X-ray emission band spectra of aluminum-magnesium alloys using experimental techniques is discussed. The Al L sub 2,3 and Mg L sub 2,3 emission spectra lying in the same wavelength region can be studied in the same spectrometer. Since the spectra of the pure metals have characteristic details and the energy resolution in this wavelength region is good, shapes and changes of shape can be registered precisely. Author

**N72-21742*#** New Mexico State Univ., University Park.
**AN L-SERIES X-RAY SPECTROSCOPIC STUDY OF THE VALENCE BANDS IN IRON, COBALT, NICKEL, COPPER, AND ZINC**
S. Hanzely (Youngstown State Univ.) and R. J. Liefeld *In* NBS Electron. Density of States Dec. 1971 p 319-327 refs Sponsored by NASA (See N72-21702 12-26)
(NASA-CR-126042) Avail: NTIS; SOD $7.75 as C 12.10:323 CSCL 20L

The soft X-ray spectroscopic method is evaluated by examining a group of neighboring elements possessing a variety of valence band properties. The emission lines studied were the threshold level L sub alpha lines obtained from high purity, polycrystalline bulk samples under bombardment by nearly monoenergetic electron beam. The associated absorption spectra were obtained as self-absorption curves from the same anode samples. Experimental and instrumental distortions were either eliminated, minimized, or explicitly corrected. The results indicate the presence of some anomalous emissions on the high energy side of the L sub alpha line in elements possessing a large density of unifilled valence levels just above the Fermi energy. The valence band emission line shape for these elements (iron, cobalt, and nickel) is found to be strongly dependent on the incident electron beam energy even for near-threshold level excitations. Analysis of the emission and self-absorption curves demonstrates that the X-ray spectroscopic method is capable of exposing meaningful differences among the valence band energy structures of the solids examined. Author

**N72-21743#** United States Steel Corp., Monroeville, Pa. Edgar C. Bain Lab. for Fundamental Research.
**THE ELECTRONIC PROPERTIES OF TITANIUM INTERSTITIAL AND INTERMETALLIC COMPOUNDS FROM SOFT X-RAY SPECTROSCOPY**
J. E. Holliday *In* NBS Electron. Density of States Dec. 1971 p 329-333 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The soft X-ray L emission spectra for titanium compounds was measured to determine the relative location of the 2p and 3d bands. The soft X-ray emission bands were measured with a grazing incidence grating spectrometer. The composition of the intermetallic compounds used for the study are illustrated. It was determined that the degree of localization and the amount and direction of electron transfer in TiC and TiN will depend on the amount of separation and position of the nonmetal 2p bands relative to the Ti3d. Author

**N72-21744#** Ludwig-Maximilians-Universitat, Munich (West Germany). Sektion Physik.
**SOFT X-RAY EMISSION SPECTRUM AND VALENCE-BAND STRUCTURE OF SILICON, AND EMISSION-BAND STUDIES OF GERMANIUM**
G. Wiech and E. Zoepf *In* NBS Electron. Density of States Dec. 1971 p 335-337 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C13.10:323

With a photon-counting concave grating spectrometer the L sub 2,3-emission band of silicon and the energy range of M sub 2,3-emission band of germanium were investigated. The Si L spectrum shows new structural details. The measured intensity distribution for both the K- and L-emission bands of silicon are compared with recent calculations of the K- and L-emission spectra and with the density-of-states curve. Author

**N72-21745#** Queens Univ., Kingston (Ontario).
**DENSITY OF STATES IN ALPHA AND BETA BRASS BY POSITRON ANNIHILATION**
W. Triftshaeuser and A. T. Stewart *In* NBS Electron Density of States Dec. 1971 p 339-342 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

Positron annihilation experiments using a long slit angular correlation apparatus have been performed to investigate the momentum distribution of photons resulting from positron annihilating with electrons in brass. Single crystals of alpha and beta brass which had been oriented along the 100, 110 and 111 directions respectively, were used for the measurements. The counter slits subtended an angle of 0.32 mrad at the sample. Thus, keeping the samples at liquid nitrogen temperature to reduce the positron motion, a total resolution of 0.42 mrad was achieved. The results show clearly deviations from a spherical Fermi surface. The observed anisotropies are found to agree very well with the theoretical predictions based on cross-sectional areas of the Fermi surface. Author

**N72-21746#** Bell Telephone Labs., Inc., Murray Hill, N.J.
**COMPTON SCATTERING FROM LITHIUM AND SODIUM**
P. Eisenberger and P. H. Schmidt *In* NBS Electron. Density of States Dec. 1971 p 345-346 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The application of the Compton effect to measure the ground state electronic linear momentum distribution function is discussed. The results on single crystals of lithium and sodium are presented. Studies using helium, hydrogen, and potassium are described to provide evidence of the accuracy of the technique. It is determined that this method provides kinetic energy and momentum distribution information which cannot be determined by the positron annihilation method. Author

**N72-21747#** Bell Telephone Labs., Inc., Murray Hill, N.J.
**ION NEUTRALIZATION SPECTROSCOPY** c14
H. D. Hagstrum *In* NBS Electron Density of States Dec. 1971 p 349-357 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The ion-neutralization spectroscopy (INS) is discussed in comparison with other spectroscopies of solids. It is shown that INS probes the local density of states of the solid at or just outside the solid surface. It is believed that this accounts for the clear-cut differences between INS results and those of other spectroscopies. Because of its unique specificity to the surface region INS is particularly useful in studying the surface electronic structures of atomically clean surfaces and of surfaces having ordered arrays of known atoms adsorbed upon them. In the latter case INS determines a portion of the molecular orbital

spectrum of surface molecules formed from the adsorbed foreign atom and surface atoms of the bulk crystal. Such spectra provide information on local bonding symmetry and structure and electrical charging within the surface molecule which is as yet unavailable by any other method. INS is the first attempt to base a spectroscopy of electronic states on a two-electron process. More recent work on experimental and mathematical problems which such a spectroscopy entails are also mentioned. Author

**N72-21748*#** Northwestern Univ., Evanston, Ill. Dept. of Materials Science.
**POTENTIAL AND CHARGE DENSITY NEAR THE INTERFACE OF A TRANSITION METAL**
E. B. Kennard and J. T. Waber *In* NBS Electron. Density of States Dec. 1971 p 359-374 refs Sponsored in part by NASA and ARPA (See N72-21702 12-26)
(NASA-CR-126043) Avail: NTIS; SOD $7.75 as C13.10:323 CSCL 20L

The early literature on methods of calculating surface energy and charge density and of dealing with potential barriers at an interface are reviewed. The three dimensional potentials and charge densities were obtained by superimposing the relevant atomic information which had been obtained from Dirac-Slater self-consistent field calculations on free atoms. The total charge density at each point P was found by summing the contributions from atoms located within a sphere of radius R centered at P. The local exchange potential was estimated at P by means of Slater's cube root of rho method. This was included with the overlapped atomic Coulomb potentials to obtain the crystal potential near the surface. Author

**N72-21749#** National Bureau of Standards, Washington, D.C.
**VIRTUAL IMPURITY LEVEL DENSITY OF STATES AS INVESTIGATED BY RESONANCE TUNNELING**
J. W. Gadzuk, E. W. Plummer, H. E. Clark, and R. D. Young *In its* Electron. Density of States Dec. 1971 p 375-379 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The analogy between a virtual electronic state of an atom adsorbed on a metal surface and an Anderson type magnetic impurity state is pointed out. The density of states of the impurity can be characterized through a knowledge of the host induced shift and broadening of the atomic state. This density of states can be related to the current-voltage characteristics in a field-emission resonance tunneling experiment in the same manner as for describing spin flip Kondo type resonance tunneling in junctions. Experimental current-voltage (field-emission total energy distribution) characteristics for single zirconium, barium, and calcium atoms on atomically perfect tungsten surfaces are analyzed in terms of the resonance tunneling theory described here and the virtual impurity level density of states is thus determined. Preliminary results for a metal-thin semiconductor-vacuum junction are also discussed.
Author

**N72-21750#** National Bureau of Standards, Washington, D.C.
**WHAT PROPERTIES SHOULD THE DENSITY OF STATES HAVE IN ORDER THAT THE SYSTEM UNDERGOES A PHASE TRANSITION?**
P. H. E. Meijer *In its* Electron. Density of States Dec. 1971 p 381-384 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The density of states problem in a system that undergoes a phase transition is examined. The question of what conditions the density of state function of the total system should have to produce a phase transition is presented. Mathematical models based on Laplace transforms are used to obtain the density information required. It is determined that a vertical slope is necessary to produce a phase transition. Author

**N72-21751#** Naval Research Lab., Washington, D.C.
**ON DERIVING DENSITY OF STATES INFORMATION FROM CHEMICAL BOND CONSIDERATIONS**
F. L. Carter *In* NBS Electron. Density of States Dec. 1971 p 385-405 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The deriving of density of states information from analysis of chemical bonds is discussed. It is determined that the momentum distribution function is compressed in the direction of the internuclear axis. Based on this concept, it is shown that a CCP transition for copper and its momentum distribution function direction can be determined. It is concluded that the valence bond concepts of bond hybridization and bond order coupled with known structure and bond distances can be used to suggest band shapes, filling, and hybridization. Author

**N72-21752#** Naval Weapons Center, China Lake, Calif. Michelson Lab.
**ELECTROREFLECTANCE OBSERVATION OF BAND POPULATION EFFECTS IN InSb**
R. Glosser, B. O. Seraphin, and J. E. Fischer *In* NBS Electron. Density of States Dec. 1971 p 407-410 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

It is found that bias changes applied to n-InSb produce shifts in portions of the electroreflectance spectra. We attribute this to changes in the conduction band population produced as the separation between the Fermi level and the bottom of the conduction band is varied. Spectra which displays red, blue, or no shift correlates to electronic transitions starting from, ending at, or bridging the Fermi level. These observations permit a band structure identification of the shifting spectra and optical monitoring of the surface potential. Author

**N72-21753#** Naval Weapons Center, China Lake, Calif. Michelson Lab.
**SPIN ORBIT EFFECTS IN THE ELECTROREFLECTANCE SPECTRA OF SEMICONDUCTORS**
B. J. Parsons and H. Piller *In* NBS Electron. Density of States Dec. 1971 p 411-415 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

Measurements have been made of the electroreflectance spectra of germanium, gallium arsenide and gallium antimonide in the range of photon energies from 0.6 to 6.7 eV. Special attention has been paid to the resolution of multiplicity within the E sub zero prime and E sub 1 prime structures. The identification of these structures in terms of critical point interband transitions involving the second conduction band has an important bearing on the band structure of these materials. The data is discussed in terms of the possible identification, within these higher energy multiplets, of spin-orbit splittings associated with the valence band states at gamma and L.
Author

**N72-21754#** Illinois Univ., Urbana. Dept. of Physics.
**EXPERIMENTAL VERIFICATION OF THE PREDICTIONS OF THE FRANZ-KELDYSH THEORY AS SHOWN BY THE INTERFERENCE OF LIGHT AND HEAVY HOLE CONTRIBUTIONS TO THE ELECTROREFLECTANCE SPECTRUM OF GERMANIUM**
P. Handler, S. Jasperson, and S. Koeppen *In* NBS Electron. Density of States Dec. 1971 p 417-421 refs (See N72-21702 12-26)
(Contracts ARPA SD-131; DAHC04-67-C-0025)
Avail: SOD $7.75 C 13.10:323

By use of improved experimental techniques and samples of particular impurity concentration, as many as eleven half oscillations in electroreflectance spectra of germanium at the direct edge at room temperature have been observed. In addition, near the experimental sixth half oscillation where the light and heavy hole contributions are of opposite signs, destructive interference was observed which greatly modified the signal lineshape in that region. The unique characteristics of the resultant lineshape allowed, the determination of the relative magnitudes of the dipole matrix elements and reduced masses for the two bands in a region of k-space somewhat removed

from the gamma-point. The experimental results also demonstrated that neither thermal broadening nor field inhomogeneity need be a problem in electroreflectance measurements. Author

**N72-21755#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**VARIATIONS OF INFRARED CYCLOTRON RESONANCE AND THE DENSITY OF STATES NEAR THE CONDUCTION BAND EDGE OF InSb**
E. J. Johnson and D. H. Dickey *In* NBS Electron. Density of States Dec. 1971 p 423-430 refs Sponsored by AF (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The electronic density of states near the conduction band edge of InSb with and without a magnetic field is obtained from dispersion relations based upon conduction band interactions with nearby bands and parameters determined and confirmed by several intraband experiments including fundamental cyclotron resonance, spin resonance, spin-flip cyclotron resonance, phonon assisted cyclotron resonance and harmonics of cyclotron resonance. The density of states displays effects due to nearby band interactions and due to electron-phonon interaction.
Author

**N72-21756#** Bell Telephone Labs., Inc., Murray Hill, N.J.
**CYCLOTRON RESONANCES OF HOLES IN Ge AT NONCENTRAL MAGNETIC CRITICAL POINTS**
J. C. Hensel and K. Suzuki *In* NBS Electron. Density of States Dec. 1971 p 431-435 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The anomalous, quantum cyclotron resonance spectrum of holes in the degenerate valence bands of Ge was analyzed utilizing the concept of a critical point in the magnetic joint density of states. Contrary to previous work done for k sub H = 0 (where k sub H is the hole wave vector along the magnetic field) these results indicate that cyclotron resonance lines originating at critical points away from k sub H = 0 are responsible for most of the prominent features of the observed quantum spectrum in Ge. Author

**N72-21757#** California Univ., Berkeley. Dept. of Electrical Engineering and Computer Sciences.
**LANDAU LEVEL BROADENING IN THE MAGNETO-OPTICAL DENSITY OF STATES**
B. H. Sacks and B. Lax (MIT, Cambridge) *In* NBS Electron. Density of States Dec. 1971 p 437-450 refs (See N72-21702 12-26)
(Grant AF-AFOSR-1488-68)
Avail: SOD $7.75 as C 13.10:323

A convolution integral expression of the optical density of states for k-conserving transitions between broadened Landau levels in crystalline solids was derived. The convolution was between single Landau level densities of states expressed in a form derived by Kubo. The expression included as parameters the reduced mass, magnetic field strength, and the strength of the broadening mechanism. The results of numerical evaluation of this expression for various values of the parameters are presented. Author

**N72-21758#** United Kingdom Atomic Energy Authority, Harwell (England). Theoretical Physics Div.
**THE ELECTRONIC STRUCTURE OF DISORDERED ALLOYS**
J. L. Beeby *In* NBS Electron. Density of States Dec. 1971 p 453-463 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The problem of calculating the electronic density of states in an alloy is considered from first principles. Choosing a suitably simplified model potential, a diagrammatic expansion is discussed within which the various existing theories can be compared. Some comments are made on the comparison with experiment. Author

**N72-21759#** California Univ., La Jolla. Dept. of Physics.
**LOCAL THEORY OF DISORDERED SYSTEMS**
W. H. Butler and W. Kohn *In* NBS Electron. Density of States Dec. 1971 p 465-470 refs Sponsored by ONR and NSF (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

Noninteracting electrons moving in the field of interacting disordered scattering centers were investigated, with attention focused especially on the electronic density of states. The macroscopic system was represented by an average over small neighborhoods. For a highly disordered system the physical properties near a given point depend only on circumstances in a small neighborhood, whose dimension is of the order of a mean free path. Consequently, a macrosystem can be treated neighborhood by neighborhood and the macroproblem can be reduced to an ensemble of microproblems. It is shown that the errors of such a procedure can be made to vanish exponentially with the size of the neighborhood. A numerical model calculation confirmed these considerations. Author

**N72-21760#** Brown Univ., Providence, R.I. Dept. of Physics.
**DENSITY OF ELECTRON LEVELS FOR SMALL PARTICLES**
L. N. Copper and S. Hu *In* NBS Electron. Density of States Dec. 1971 p 473-476 refs Sponsored by ARPA and NSF (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The density of electronic levels for small particles was calculated. This differs from the usual expression which is valid as the volume of the sample becomes very large. The leading term of the correction is proportional to the surface/volume of the sample. Depending on the environment the density of electronic levels may be increased or decreased. Author

**N72-21761#** Waterloo Univ. (Ontario). Quantum Theory Group.
**ONE-DIMENSIONAL RELATIVISTIC THEORY OF IMPURITY STATES**
M. Steslicka, S. G. Davison, and A. G. Brown *In* NBS Electron. Density of States Dec. 1971 p 477-481 refs Sponsored by NRC (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The one-dimensional Dirac equation was solved for the Kronig-Penney model containing a delta potential impurity. Depending on certain existence conditions, the impurity states can be classified into two types called relativistic and Dirac impurity states. In the nonrelativistic limit, the Dirac states disappear and the relativistic ones become the ordinary impurity states. A detailed discussion is given of the complete energy spectrum. Author

**N72-21762#** Battelle Memorial Inst., Columbus, Ohio. Metal Science Group.
**THE INFLUENCE OF GENERALIZED ORDER-DISORDER ON THE ELECTRON STATES IN FIVE CLASSES OF COMPOUND-FORMING BINARY ALLOY SYSTEMS**
E. W. Collings, J. E. Enderby, and J. C. Ho *In* NBS Electron. Density of States Dec. 1971 p 483-492 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The influence of generalized order-disorder (including solid state order-disorder, and melting) on electronic structures is discussed for various types of binary intermetallic compounds which are arbitrarily subdivided into five classes. Classes A and B exhibit solid-state order-disorder (O-D) reactions. In the first of these the atomic potentials are sufficiently similar that the use of low order perturbation theory at all concentrations is valid. The effect of O-D on such alloys is described in relationship to the density of states, as measured by low temperature specific heat and magnetic susceptibility, and to the electrical transport properties, particularly the conductivity and Hall coefficient. A second type of system is considered in which the potentials are sufficiently different as to produce bound states which appear in the ordered form. The disappearance of these bound states when the alloy disorders gives rise to characteristic electronic behavior.

In class C, which is metallic in the solid, and in classes D and E which are semiconducting in the solid, structural order persists up to the melting point. For D the liquid is metallic, and data are presented for Bi2Te3, a typical system of this class. The conditions for the existence of intermetallics of class E are extreme, and give rise to nonmetallic behavior in the liquid. These various systems are discussed in terms of differences in atomic potentials. The major problems involved in giving precise estimates of the required differences are outlined and a critical account of the use of concepts like the electronegativity parameter are presented. Author

N72-21763# Lincoln Lab., Mass. Inst. of Tech., Lexington.
**LOCALIZED STATES IN NARROW BAND AND AMORPHOUS SEMICONDUCTORS**
D. Adler and J. Feinleib *In* NBS Electron. Density of States Dec. 1971 p 493-504 refs Avail: SOD $7.75 as C 13.10:323 (See N72-21702 12-26)

The electronic density-of-states is discussed in situations where some of the states near the Fermi energy are localized, due to either intraionic Coulomb repulsion or disorder. When localized states are present, the Franck-Condon principle necessitates separate electrical and optical densities of states. In the case of ionic Mott insulators, it is shown that doping or nonstoichiometry drastically affects the energy band structure. For the particular example of NiO, introduction of Li(+) impurities or excess oxygen leads to a large upward displacement of the 2p band associated with the oxygen ions, moving it sufficiently near the Fermi level that hole conduction in the 2p band predominates above 200 K, in agreement with the available experimental data. In the case of amorphous semiconductors, it is shown that introduction of electron-electron and electron-phonon interactions results in a shift of the relative position of the localized parts of the valence and conduction bands, as well as shifts of the localized states relative to the itinerant states. However, the qualitative features of the model of Cohen et al. are preserved. Author

N72-21764*# Chicago Univ., Ill. James Franck Inst.
**A CLUSTER THEORY OF THE ELECTRONIC STRUCTURE OF DISORDERED SYSTEMS**
K. F. Freed and M. H. Cohen *In* NBS Electron. Density of States Dec. 1971 p 505-508 refs Sponsored in part by NASA, AROD, and ARPA (See N72-21702 12-26)
(NASA-CR-126044) Avail: NTIS; SOD $7.75 as C 13.10:323 CSCL 20L

The equation of motion for the averaged Green's function in an alloy couples the latter to the Green's function for which the average is restricted so that the composition of one atom is held fixed. The average Green's function may be regarded as the Green's function for a zero-atom cluster, and it is coupled to the Green's function for a one-atom cluster. There is thus an infinite hierarchy of equations of motion in which the n-atom functions are coupled to the (n + 1)-atom functions. The coherent potential approximation of Soven corresponds to truncation in the equation of motion of the one-atom function. The coherent potential theory is generalized to a theory of n-atom functions with truncation in the equation of motion of the (n + 1)-atom function. The formalism is developed, and a few of the results obtained are presented. Author

N72-21765# Roorkee Univ. (India). Dept. of Physics.
**T MATRIX THEORY OF DENSITY OF STATES IN DISORDERED ALLOYS: APPLICATION TO BETA BRASS**
M. M. Pant and S. K. Joshi *In* NBS Electron. Density of States Dec. 1971 p 509-514 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The T matrix theory of electronic states in disordered systems has been used to determine the spectral density for states of various symmetries for binary alloys. Soven's averaged matrix procedure was improved by retaining the distinction between the t matrices of the constituents and introducing partial Greenians of the Pant-Joshi theory. Information about the pair correlation function obtained by critical neutron scattering method was used to evaluate the partial Greenians as well as the crystalline potentials for the constituents. In order to facilitate computation of the t matrices the t matrices these potentials have been replaced by energy dependent model potentials. The parameters of the model potentials were determined by the requirement that they yield logarithmic derivatives identical with those generated by the real potentials. The scheme has been applied to disordered beta-brass. The separation in energy of the peaks of the spectral density of states at the high symmetry points of the Brillouin zone, are compared with experimental results, and with the results obtained by the virtual crystal approximation. Author

N72-21766# Pittsburgh Univ., Pa. Dept. of Physics.
**ON THE TERMS EXCLUDED IN THE MULTIPLE-SCATTERING SERIES**
R. M. More *In* NBS Electron. Density of States Dec. 1971 p 515-519 refs (See N72-21702 12-26)
(Grant AF-AFOSR-1678-69)
Avail: SOD $7.75 as C 13.10:323

Certain of the excluded terms in the multiple scattering series for a simple soluble potential have been evaluated. Three aspects of the result are discussed: (1) the reduction to on-shell quantities; (2) the numerical contribution of the excluded terms; and (3) the analytic properties of these terms. Author

N72-21767# Bristol Univ. (England). H. H. Wills Physics Lab.
**ON NON-LOCALIZATION AT THE CENTRE OF A DISORDERED BOUND BAND**
F. Brouers *In* NBS Electron. Density of States Dec. 1971 p 521-526 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

It is shown for a three dimensional model of tightly bound electrons with cellular disorder that the electronic states at the middle of a continuous band cannot be strictly localized. This conclusion is just the opposite of what has often been suggested. Nevertheless, an approximate calculation of the electron localization life time suggests that with increasing disorder the localized character of the electron states become more and more pronounced. It is argued that in such a system there is no sharp transition between localized and nonlocalized regions of the energy spectrum. Author

N72-21768# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
**THE HALF-FILLED NARROW ENERGY BAND**
L. G. Caron and G. Kemeny *In* NBS Electron. Density of States Dec. 1971 p 527-541 refs Sponsored in part by NRC (See N72-21702 12-26)
(Contract Nonr-78721)
Avail: SOD $7.75 as C 13.10:323

The antiferromagnetic and paramagnetic states of a half-filled narrow energy band were investigated using a t-matrix approach. This method is justified despite the high particle density in the system. A phase diagram including the Mott state is given. Employing the gap of the antiferromagnetic insulator as a variational parameter, it is shown that the increase of the band width potential energy ratio leads to a first order phase transition into the paramagnetic metal state, nearly where Mott has estimated it to occur. Author

N72-21769# Maryland Univ., College Park.
**ELECTRONIC STRUCTURE OF GOLD AND ITS CHANGES ON ALLOYING**
E. Erlbach (City Coll. of CUNY, N. Y.) and D. Beaglehole *In* NBS Electron. Density of States Dec. 1971 p 545-550 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The changes in reflectivity upon alloying small amounts of Ag, Cu, and Fe into Au have been measured. By means of a Kramers-Kronig analysis, the changes in dielectric constant

produced by this alloying have been determined. These changes have been related to shifts in the position and character of the electron energy bands in gold. Author

**N72-21770#** Chalmers Univ. of Technology, Goteborg (Sweden).
**DENSITY OF STATES OF AgAu, AgPd, AND AgIn ALLOYS STUDIED BY MEANS OF THE PHOTOEMISSION TECHNIQUE**
P. O. Nilsson *In* NBS Electron. Density of States Dec. 1971 p 551-555 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The density of states of AgAu, AgPd, and AgIn alloys have been studied by means of the photoemission technique. General trends of the results are compared with the predictions from simple models of alloys. The rigid-band or virtual-crystal approximation cannot explain the results, while model calculations in the coherent potential approximation reproduces the observed density of states. The Friedel screening theory explains the shift of the Fermi level on alloying. Author

**N72-21771#** Illinois Univ., Urbana.
**DENSITY OF STATES INFORMATION FROM LOW TEMPERATURE SPECIFIC HEAT MEASUREMENTS**
P. A. Beck and H. Claus *In* NBS Electron. Density of States Dec. 1971 p 557-563 refs Sponsored by Army Res. Office *and NSF (See N72-21702 12-26)*
Avail: SOD $7.75 as C 13.10:323

The calculation of one-electron density of state values from the coefficient gamma of the term of the low temperature specific heat linear in temperature is complicated by many-body *effects. In particular, the electron-phonon interaction may enhance* the measured gamma as much as twofold. The enhancement factor can be evaluated in the case of superconducting metals and alloys. In the presence of magnetic moments, additional complications arise. A magnetic contribution to the measured *gamma was identified in the case of dilute alloys and also of* concentrated alloys where parasitic antiferromagnetism is superimposed on an overall ferromagnetic order. No method has as yet been devised to evaluate this magnetic part of gamma. The separation of the temperature linear term of the specific heat may itself be complicated by the appearance of a specific heat anomaly due to magnetic clusters in superparamagnetic or weakly ferromagnetic alloys. Author

**N72-21772#** Nagoya Univ. (Japan). Dept. of Physics.
**ELECTRONIC DENSITY OF STATES DETERMINED BY ELECTRONIC SPECIFIC HEAT MEASUREMENTS**
*T. Mamiya and Y. Masuda In NBS Electron. Density of States* Dec. 1971 p 565-568 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The superconducting transition temperatures, electronic specific heats, and Debye temperatures have been measured for 5d transition-metal alloy-series Ta-Re. By *making use of these* data and the theoretical predictions by McMillan, the electron-phonon coupling constant and bare electronic density of *states have been determined. The density of states is compared* with the theoretical one derived from band structure calculations of Ta using the augmented plane wave method by Mattheiss. Author

**N72-21773#** Michigan State Univ., East Lansing.
**LOW-TEMPERATURE SPECIFIC HEATS OF HEXAGONAL CLOSE-PACKED ERBIUM-THULIUM ALLOYS**
A. V. S. Satya and C. T. Wei *In* NBS Electron. Density of States Dec. 1971 p 571-577 refs (See N72-21702 12-26)
(Grant NSF GK-2224)
Avail: SOD $7.75 as C 13.10:323

*The specific heats of hexagonal close-packed erbium and* thulium metals, and three of their isostructural alloys were measured in the liquid helium temperature range between 1.3 and 4.2 K for examining the validity of the localized 4 band model, on which the current theories of the rare earth metals are based. Barring possible uncertainties in the magnetic properties of the samples and their impurity contents, the coefficients of the specific heat component linear in temperature calculated from the present data range in values approximately two to twenty times the constant electronic specific heat coefficient predicted by the above model for all the hexagonal close-packed rare earth lanthanides. Possible explanations for such discrepancies are discussed. An itinerant 4 band model based on the one-electron-band model suggested by Mott is proposed for the lanthanides as an alternative to the localized 4 band model. Author

**N72-21774#** Michigan State Univ., East Lansing. Dept. of Metallurgy, Mechanics and Materials Science.
**LOW-TEMPERATURE SPECIFIC HEATS OF FACE-CENTERED CUBIC Ru-Rh AND Rh-Pd ALLOYS**
P. J. M. Sang and C. T. Wei *In* NBS Electron. Density of States Dec. 1971 p 579-585 refs (See N72-21702 12-26)
(Grant NSF GK-475)
Avail: SOD $7.75 as C 13.10:323

The specific heats of Rh, Pd, and a number of face centered cubic Ru-Rh and Rh-Pd alloys were determined between approximately 1.4 and 4.2 K. Whereas the C/T vs T squared plots for the Ru-Rh alloys show a straight line behavior, a low temperature anomaly is observed in similar plots for Pd and the Rh-Pd alloys below 2.2 K. This low temperature anomaly *appears to be most pronounced in the alloy Rh0.78Pd0.22,* and diminishes with increasing Rh or Pd. The electronic specific heats of these alloys are generally high with a minimum occurring at Ru0.30Rh0.70. A portion of the total density of states curve for the outer electronics in face centered cubic *transition metals was derived numerically from the present* results and those available in the literature as a first approximation. Such a curve shows qualitative agreement with the first peak below Fermi level of the theoretical total s-d energy band of Pd calculated by Janak et al. Author

**N72-21775#** Battelle Memorial Inst., Columbus, Ohio.
**DENSITY OF STATES OF TRANSITION METAL BINARY ALLOYS IN THE ELECTRON-TO-ATOM RATIO RANGE 4.0 TO 6.0**
E. W. Collings and J. C. Ho *In* NBS Electron. Density of States Dec. 1971 p 587-596 refs Sponsored by AFML (See *N72-21702 12-26)*
Avail: SOD $7.75 as C 13.10:323

Using Ti-Mo as a *prototype of binary bcc transition alloys,* densities of states at the Fermi level have been studied using low temperature specific heat augmented by magnetic *susceptibility (chi) measurements. A survey of literature has* revealed that the principal descriptors of density of states (gamma) and superconducting critical temperature (T sub c), generally decrease as e/a decreases below about e/a approximately 4.3 to 4.5. Since the region e/a < or approximately 4.5 *also corresponds to that in which a submicroscopic hexagonal* structured precipitate (omega phase) always appears in quenched alloys, a detailed study of microstructure was undertaken in *conjunction with the electronic property measurements. It was* concluded that a steadily increasing abundance of omega phase precipitate was responsible for observed drops in gamma, T sub c, and chi below e/a equal to or approximately 4.5. Using magnetic susceptibility at elevated temperatures it has been *shown that Fermi surface bcc increases monotonically as e/a is* reduced from 6 to 4. Author

**N72-21776#** National Bureau of Standards, Washington, D.C. Inst. for Materials Research.
**RELEVANCE OF KNIGHT SHIFT MEASUREMENTS TO THE ELECTRONIC DENSITY OF STATES**
*L. H. Bennett, R. E. Watson (Brookhaven National Lab.), and G.* C. Carter *In its* Electron. Density of States Dec. 1971 p 601-643 refs Sponsored by AEC (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The methods developed for relating Knight shift (K) to the

electronic properties for most of the types of cases encountered in the literature are reviewed. Simple metals including problems of orbital magnetism and changes in K caused by electronic transitions such as melting are discussed. Knight shifts and their temperature dependence in metals and intermetallic compounds involving unfilled d shells, are discussed. Estimates are given of atomic hyperfine fields due to single electrons, appropriate to those cases where problems due to electronic configurations do not make deductions from experiment too ambiguous. A density of states curve calculated for Cu is given, showing the relative importance of s-p, and d character for that metal. In a qualitative sense this Cu curve implies such information for other transition metals. Alloy solid solutions are discussed for the cases where a rigid band model might be used to explain the results, and for cases where local effects have to be taken into account. The charge oscillation and RKKY approaches and their limitations are reviewed for cases of dilute nonmagnetic and d- or f-type impurities. Author

N72-21777# Massachusetts Inst. of Tech., Cambridge. Francis Bitter National Magnet Lab.
**PAULI PARAMAGNETISM IN METALS WITH HIGH DENSITIES OF STATES**
S. Foner *In* NBS Electron. Density of States Dec. 1971 p 645-648 refs Sponsored by AFOSR (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

Commparisons with independent low temperature electronic specific heat measurements are discussed and attempts to derive density of states N(O) from both susceptibility and specific heat are reviewed. Properties of Pd systems are reviewed and estimates of N(O) and electron-electron interaction potential are examined. The possibilities of applying large magnetic fields and thereby independently measuring N(O) and small changes of N(O) near the Fermi energy by such studies are discussed. Author

N72-21778# Northern Illinois Univ., Dekalb.
**KNIGHT SHIFTS OF THE ALKALI METALS**
A. Meyer, G. M. Stocks (Sheffield Univ.), and W. H. Young (Sheffield Univ.) *In* NBS Electron. Density of States Dec. 1971 p 651-658 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

K, Rb and Cs, being leading members of transition series, have pseudoatoms with virtual bound d states; Li has a somewhat analogous p state. By contrast, Na has no such states. Evidence is offered of how the associated scattering accounts for the following observed electron transport properties: under pressure, the resistance of Li rises and, eventually, so do those of Cs, Rb and K; and the thermopower of Li is anomalous (positive) and stays so under pressure while that for Cs very quickly becomes positive when pressure is applied. The same features can now be used in the theory of Knight shifts to explain the following observations. (1) The conduction electron susceptibility for Li is enhanced very significantly above that for free (and even interacting) electrons. (2) Nuclear contact density in Li is much lower than that predicted by one-OPW theory. (3) Knight shifts of Li and Na decrease and those for Rb and Cs increase when pressure is applied. (4) Knight shift for a given ion increases when it is successively resonated in Na, K, Rb, and Cs matrices. The key to the interpretation of (3) and (4) is the variation in the density of states (and therefore susceptibility) under conditions of pressure change and alloying. Author

N72-21779# Utah Univ., Salt Lake City. Dept. of Physics.
**ROLE OF EXCHANGE EFFECTS ON THE RELATIONSHIP BETWEEN SPIN SUSCEPTIBILITY AND DENSITY OF STATES OF DIVALENT METALS**
P. Jena, T. P. Das, S. D. Mahanti (Bell Telephone Labs., Inc., Murray Hill, N. J.), and G. D. Gaspari (Calif. Univ., Santa Cruz) *In* NBS Electron. Density of States Dec. 1971 p 659-663 refs Sponsored in part by NSF (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

Semiempirical estimates of the spin susceptibility were made for Mg and Cd by adjusting the measured Knight shifts with theoretical estimate values of the core polarization and spin density. The values of the spin susceptibility so deduced are compared to theoretical estimates made by the method of Silverstein, who treated the exchange enhancement by an interpolation procedure analogous to that of Nozieres and Pines for calculating correlation energies, and included the effects of band structure through the calculated thermal (band) effective mass. Agreement is good for Mg, which behaves more like a free electron metal, and poor for Be and Cd. Possible sources of the discrepancies are discussed. Author

N72-21780# National Bureau of Standards, Washington, D.C. Inst. for Materials Research.
**CORRELATION OF CHANGES IN KNIGHT SHIFT AND SOFT X-RAY EMISSION EDGE HEIGHT UPON ALLOYING**
L. H. Bennett, A. J. McAlister, J. R. Cuthill, and R. C. Dobbyn *In its* Electron. Density of States Dec. 1971 P 665-670 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

In simple metals and alloys (those having no significant local d-character at or near the Fermi level) the Knight shift provides a measure of the local s-electron density of states. If the particular atom under study has a p-like core level, the then soft X-ray emission arising from transitions of electrons at the Fermi level into p-like core vacancies should provide a similar measure. Using Al as the example, results of these two techniques are compared by studying fractional changes, relative to Al metal, of the Knight shift and L(2,3) soft X-ray emission edge height of Al in NiAl, AuAl2, Mg2Al3, Mg17Al12, and Al2O3. A distinct correlation is observed. Author

N72-21781# Bell Telephone Labs., Inc., Murray Hill, N.J.
**TUNNELING MEASUREMENTS OF SUPERCONDUCTING QUASI-PARTICLE DENSITY OF STATES AND CALCULATION OF PHONON SPECTRA**
J. M. Rowell *In* NBS Electron. Density of States Dec. 1971 p 673-680 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The tunneling technique, which has proved incredibly successful in the study of superconductivity, gives little information about the normal state properties of metals and semiconductors. It is shown that, in the determination of the superconducting quasi-particle density of states, it is the change in density induced by the onset of superconductivity which is measured rather than the total density. Returning to the problem of normal materials, a review of the limited achievements and failures of tunneling is presented. This includes the influence of band edges on tunneling in p-n diodes and metal-semiconductor contacts, the structures observed in tunneling into bismuth and the negative results obtained in nickel and palladium. The dominant effect of the change in barrier shape in most of these tunneling characteristics is illustrated. Author

N72-21782# Illinois Univ., Urbana. Materials Research Lab.
**DENSITY OF STATES FROM SUPERCONDUCTING CRITICAL FIELD MEASUREMENTS**
G. Dummer and D. E. Mapother *In* NBS Electron. Density of States Dec. 1971 p 681-684 refs (See N72-21702 12-26) (Contract ARPA SD-131)
Avail: SOD $7.75 as C 13.10:323

For the temperature range below 1 K, precise static measurements of the critical field and absolute temperature permit determination of the ratio, gamma* = (temperature coefficient of the normal electronic specific heat)/(molar volume), with a relative accuracy of about 1:3000. This method was used to study the change in gamma* under hydrostatic pressures up to 1000 atm for In and Tl. Nonlinear changes in gamma* are clearly resolved, despite the relatively low values of applied pressure. For In the values of gamma* show a parabolic decrease with increasing pressure. The results for Tl show an initial increase in gamma* which reaches a maximum near 500

atm. For larger pressures the value of gamma* shows normal decrease with increasing pressure. Author

N72-21783# Nagoya Univ. (Japan). Dept. of Applied Physics.
**TEMPERATURE DEPENDENCE IN TRANSPORT PHENOMENA AND ELECTRONIC DENSITY OF STATES FOR TRANSITION METALS**
M. Shimizu *In* NBS Electron. Density of States Dec. 1971 p 685-691 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The calculated results of the temperature variations of electronic specific heat and spin susceptibility are briefly summarized. The empirical densities of states, which were determined in the rigid band model from the experimental data of low temperature specific heat coefficient, were used. The electrical resistivity, thermal conductivity, and thermoelectric power were calculated at high temperatures for Pd, Pt, Rh, Ir, Mo, and W by assuming appropriate electronic structures and the empirical densities of states. The calculated temperature dependences of electrical resistivity, thermal conductivity, and thermoelectric power and the sign of the thermoelectric power at high temperatures are found to be strongly dependent on the shape of the density of states and the position of the Fermi level, and are consistent with the experimental results. There is a strong correlation between these temperature dependences and those of the electronic specific heat and spin susceptibility. Author

N72-21784# California Univ., Los Angeles.
**METAL SEMICONDUCTOR BARRIER JUNCTION TUNNELING STUDY OF THE HEAVILY DOPED n-TYPE SILICON DENSITY OF STATES FUNCTION**
Y. Hsia and T. F. Tao *In* NBS Electron. Density of States Dec. 1971 p 693-713 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

Experimental data showing the dependency of the Fermi level on the dopant types of the heavity doped n-type silicon are reported. A dopant type dependent density of states effective mass is postulated to describe the effect of different dopants on the Fermi level. The deviation of the experimental data curve from the calculated curve is ascribed to the effect of degenerate semiconductor band tailing. In addition, through interpretation of incremental conductance versus applied bias characteristic curves of the different tunnel junction evaluated, a consistent description of the density of states function of the heavily doped silicon is obtained. The density of states function, dependent on the dopant type and dopant concentration, is generally parabolic above the band edge, but towards the band tailing can be severe. Author

N72-21785# Maryland Univ., College Park. Inst. for Molecular Physics.
**THE EFFECT OF HYDROSTATIC PRESSURE ON THE GALVANOMAGNETIC PROPERTIES OF GRAPHITE** c18
I. L. Spain *In* NBS Electron. Density of States Dec. 1971 p 717-725 refs Sponsored by AEC (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

Measurements of the Hall effect and magnetoresistance in crystals of graphite with current flow in the basal planes at high pressures are described. Galvanomagnetic measurements enable the magneto conductivity tensor components to be obtained, and from them the electron and hole densities and mobilities. The results are compared with the band model for the semi-metal graphite proposed by Slonczewski and Weiss. Of particular interest is the information that these results give about the assignment of carriers at the symmetry point K in the Brillouin zone of graphite and the properties of mobile minority carriers. Author

N72-21786# Worcester Polytechnic Inst., Mass. Dept. of Chemistry.
**ELECTRICAL RESISTIVITY AS A FUNCTION OF HYDROGEN CONCENTRATION IN A SERIES OF PALLADIUM-GOLD ALLOY**
A. J. Maeland *In* NBS Electron. Density of States Dec. 1971 p 727-729 refs Sponsored by AEC (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The changes occurring in the electrical resistance of a series of gold-palladium alloys during hydrogen absorption were measured. The results are presented for each alloy in the form of relative resistance, R/R sub O vs hydrogen concentration H/M;R is the resistance of a particular gold-palladium alloy containing a certain amount of hydrogen, given by H/M, the atomic ratio of hydrogen to metal, and R sub O is the resistance of the same hydrogen free alloy. For pure palladium the relative resistance increased as a function of hydrogen concentration to a maximum value of approximately 1.80 at H/M approximately 0.75; further hydrogen absorption results in a decrease in relative resistance. Similar maxima are found in some gold-palladium alloys; however, the maxima occurs at decreasing relative resistance values and also shifts to lower H/M values with increasing gold concentrations. At sufficiently high gold contents the maximum disappears and a continuous decrease in resistance with increasing hydrogen content occurs. The results are evaluated in terms of the band model. Author

N72-21787# Eidgenossische Technische Hochschule, Zurich (Switzerland). Lab. fuer Festokoerperphysik.
**THE VOLUME DEPENDENCE OF THE ELECTRONIC DENSITY OF STATES IN SUPERCONDUCTORS**
R. I. Boughton, J. L. Olsen, and C. Palmy *In* NBS Electron. Density of States Dec. 1971 p 731-734 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10323

The volume dependence of the electronic specific heat coefficient can be obtained from measurements of the low temperature thermal expansion, from observations on the pressure dependence of the superconducing threshold curve, and from the volume change occurring at transition. Recent theoretical results are used to obtain values of the change in the density of states with volume from the existing experimental data for a number of metals. Author

N72-21788# Oregon Univ., Eugene. Dept. of Physics.
**ALLOY FERMI SURFACE TOPOLOGY INFORMATION FROM SUPERCONDUCTIVITY MEASUREMENTS**
H. D. Kaehn and R. J. Higgins *In* NBS Electron. Density of States Dec. 1971 p 735-736 refs Sponsored by NSF (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

Corrections to the calculation of the strain derivative of the superconduction transition temperature in the indium cadmium alloy system are discussed. The rapid variation in the alloy density of states n(E) near a singular point is taken into account by separating n(E) into a rapidly varying part and a monotonic background. The calculated impurity dependence of the pressure derivative is also compared with experimental results for Cd-doped In. N.E.N.

N72-21789# Yale Univ., New Haven, Conn.
**HYDROGENATION EFFECTS ON PALLADIUM TUNNEL JUNCTIONS**
W. N. Grant, R. C. Barker, and A. Yelon *In* NBS Electron. Density of States Dec. 1971 p 737-739 refs (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The hydrogenation effects on the electron tunneling characteristics of aluminum-oxide-palladium junctions are investigated. It is found that the impedance of the junctions increases from 1 to 5% with increasing hydrogenation, with the greatest increase occurring at large positive bias on the palladium. This is attributed to the introduction of electrons from hydrogen into the d-bands of palladium. Author

N72-21790# Northwestern Univ., Evanston, Ill. Dept. of Materials Science.
**CALCULATION OF THERMODYNAMIC INFORMATION BASED ON THE DENSITY OF STATES CURVES OF TWO ALLOTROPES OF IRON**
D. Koskimaki and J. T. Waber *In* NBS Electron. Density of States Dec. 1971 p 741-754 refs Sponsored by ARPA (See N72-21702 12-26)
Avail: Sod $7.75 as C 13.10:323

The density of states curves for both body centered cubic and face centered cubic iron are determined using a program which randomly interpolates between previously calculated eigenvalues to generate a large number of new energy solutions. These new eigenvalues enable a more accurate determination of density of states curves than is possible by plotting and averaging the original eigenvalues themselves. The density of states curves determined for each phase are used to obtain the energy sum of the eigenvalues of the valence electrons, the shift in the Fermi potential with temperature for the two curves, and the electronic specific heat versus temperature curves for both phases of iron over the temperature range from O K to the melting point. Author

N72-21791*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**POTENTIAL INDEPENDENT FEATURES OF CRYSTAL BAND STRUCTURE**
M. M. Saffren *In* NBS Electron. Density of States Dec. 1971 p 755-756 ref (See N72-21702 12-26)
(Contract NAS7-100)
(NASA-CR-126045) Avail: NTIS; SOD $7.75 as C 13.10:323 CSCL 20B

A brief summary is presented of the work undertaken to deduce the invariant band structure of the face-centered, body-centered, and tetragonal lattices. Author

N72-21792# Brown Univ., Providence, R.I. Dept. of Physics.
**NONLINEAR OPTICAL SUSCEPTIBILITY OF SEMICONDUCTORS WITH ZINCBLENDE STRUCTURE**
M. I. Bell *In* NBS Electron. Density of States Dec. 1971 p 757-766 refs (See N72-21702 12-26)
(Contract ARPA SD-86)
Avail: SOD $7.75 as C 13.10:323

A simple model for the band structure and electronic density of states in zincblende semiconductors is used to calculate the dispersion of the susceptibility responsible for second harmonic generation. The calculation requires no adjustable parameters, and results have been obtained for GaAs, InAs, ZnTe, and InSb in substantial agreement with experiment in the energy range 0-20 eV. Author

N72-21793*# Radio Corp. of America, Princeton, N.J.
**MODEL DENSITY OF STATES FOR HIGH TRANSITION TEMPERATURES BETA-TUNGSTEN SUPERCONDUCTORS**
R. W. Cohen, G. D. Cody, and L. J. Vieland *In* NBS Electron. Density of States Dec. 1971 p 767-773 refs (See N72-21702 12-26)
(Contract NAS8-21384)
(NASA-CR-126047) Avail: NTIS; SOD $7.75 as C 13.10:323 CSCL 20L

A simple density of states model is applied to the problem of superconductivity in high critical temperature beta-tungsten superconductors. If it is assumed that the interaction responsible for superconductivity is predominatly between d-band carriers and acoustic phonons via a deformation potential matrix element, simple analytic expressions for the effective electron-electron coupling constant lambda and critical temperature (lambda) can be obtained. The quantities lambda and critical temperature can then be estimated using parameters determined from an application of the density of states model to the cubic state elastic constants. A simple condition is established for the existence of a cubic tetragonal lattice transformation in these materials. Using the result for the critical temperature, it is found that the critical temperature is approximately greater than 15 K for all materials which exhibit a lattice transformation. Thus, the relation is established between high critical temperature superconductivity and lattice transformation in the beta-tungsten compounds. Author

N72-21794# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
**SUMMARY OF THE CONFERENCE ON ELECTRONIC DENSITY OF STATES**
H. Ehrenreich *In* NBS Electron. Density of States Dec. 1971 p 775-781 refs Sponsored in part by ARPA (See N72-21702 12-26)
(Grant NSF GP-8019)
Avail: SOD $7.75 as C 13.10:323

An overview of the conference proceedings and an evaluation of the present status of theoretical and experimental investigations are presented. Problems in performing calculations are described and include both the theoretical approach and computer time limitations. It is pointed out that few if any of the experiments correspond to creation of just one quasi-particle near the Fermi surface. Disagreements concerning the k-conservation rule are mentioned. The lack of comparison of results from different types of experiments is noted. The emphasis on a large variety of alloy systems is discussed, and the need for experimental data on single crystals and the recent progress on the theoretical front are indicated. A similarity in emphasis, techniques and materials, and interpretations to an earlier conference on optical properties and electronic structures is highlighted. N.E.N.

N72-21795# Argonne National Lab., Ill.
**DENSITY OF STATES AND NUMBERS OF CARRIERS FROM THE dHvA EFFECT**
S. Hornfeldt, J. B. Ketterson, and L. R. Windmiller *In* NBS Electron. Density of States Dec. 1971 p 785-790 refs Sponsored by AEC (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

With the dHvA effect, the angular dependence of the extremal area and effective mass over all sheets of the Fermi surface can be determined. Using recently developed techniques this data can be inverted and the angular dependence of the Fermi radius and Fermi velocity determined. Techniques are developed to allow the inversion of both open and closed surfaces. For closed surfaces an expansion in symmetry adapted spherical harmonics (to order l = 60) is used, while for open surfaces a three-dimensional Fourier series representation is used. With this information one may determine, for a given sheet of the surface, the number of carriers and density of states by performing the appropriate integrations. Author

N72-21796# California Univ., Berkeley. Lawrence Radiation Lab.
**A NOTE ON THE POSITION OF THE GOLD 5d BANDS IN AuAl2 AND AuGa2**
P. D. Chan and D. A. Shirley *In* NBS Electron. Density of States Dec. 1971 p 791-793 refs Sponsored by AEC (See N72-21702 12-26)
Avail: SOD $7.75 as C 13.10:323

The calculations leading up to the gold d-band dilemma, indicating that the states lie at a Fermi energy of -7 and are flat, are reviewed, and additional X-ray photoelectron spectroscopic measurements of the valence bands of AuAl2 and AuGa2 are discussed. Peaks were found at -6 eV, which is interpreted as giving strong support to the earlier band structure calculations. The facts that the experimental peaks are not quite as deep as the theoretical peaks and the experimental linewidth is about twice the theoretical are considered to weaken somewhat the conclusion that the bands are not important in optical phenomena. Comparisions are also made with other experimental soft X-ray emission spectra of AuAl2. N.E.N.

**N72-21797#** Northwestern Univ., Evanston, Ill. Dept. of Materials Science.

**THE RELIABILITY OF ESTIMATING DENSITY OF STATES CURVES FROM ENERGY BAND CALCULATIONS**

E. B. Kennard, D. Koskimaki, J. T. Waber, and F. M. Mueller (ANL) *In* NBS Electron Density of States Dec. 1971 p 795-800 refs Sponsored by ARPA (See N72-21702 12-26) Avail: SOD $7.75 as C 13.10:323

The density of states curve for aluminum was calculated for different initial energy bands using the quadratic interpolation method. In one case, a true parabolic energy band was used as input and in the second, the E(k) values were those obtained for aluminum using the APW method. Deviations from the parabolic density of states curve were found to be inversely proportional to the number of E(k) values per histogram box and hence inversely proportional to the square root of the number of random k points in the Brillouin zone. It was necessary to use 100,000 points to obtain a relative deviation of 0.3%. In the second case, the self consistent band calculations for 2048 points in the full Brillouin zone and for a subset of 256 of these were used as input data. The effect of increasing the number of input values was assessed for 25,000 random points in the Brillouin zone. The relative errors were 26 and 9 respectively for 256 and 2048 points. The effects of smoothing as an alternative method of reducing statistical error are also discussed. Author

**N72-21798*#** Brown Univ., Providence, R.I. Div. of Engineering.

**AN INVESTIGATION OF THE PROPERTIES OF NEW SEMICONDUCTING ALLOYS AND THEIR APPLICATION TO LUMINESCENT DEVICES Final Technical Report, 13 Sep. 1970 - 30 Jun. 1971**

Maurice Glicksman and Aaron Wold 6 Aug. 1971 65 p refs (Grant NGR-40-002-094)

(NASA-CR-111997) Avail: NTIS CSCL 20B

Crystals of alloys of GaP with ZnSe have been grown with ZnSe contents up to 8 mol percent. Study of the transport properties of n-type samples of such alloys showed a hopping contribution to the conductivity at low temperatures, and the dominance of ionized impurity scattering above about 150 K. The electron mobility decreased with increasing ZnSe content. The hopping mechanism was found to have an activation energy at low temperatures of about 4 MeV, for all of the alloys studied. Cathodoluminescent studies of the alloys showed no signs of Zn-Se donor-acceptor pair recombination. Diodes fabricated from the alloy material (by the diffusion of Zn as an acceptor impurity) showed electroluminescence at room temperature (and below), although weaker than that found from GaP diodes by as much as two orders of magnitude. For the more heavily alloyed diodes, line spectra were not seen near the band edge; in the reverse bias direction, the emission did tail out to higher energies than seen in the pure GaP diodes. Indentifiable pair-recombination emission in the alloy diodes showed a slight decrease in energy with alloying, from 1.95 to 1.91 eV on going to 5% ZnSe. Author

**N72-21799*#** Translation Consultants, Ltd., Arlington, Va.

**PREPARATION AND CRYSTAL STRUCTURE OF KAgO AND CsAgO**

H. Sabrowsky and R. Hoppe Washington NASA Apr. 1972 17 p refs Transl. into ENGLISH from Z. Anorg. Allgem. Chem. (Leipzig), v. 258, 1968 p 241-256

(Contract NASw-2038)

(NASA-TT-F-14192) Avail: NTIS CSCL 20B

Hitherto unknown KAgO (colorless) and XsAgO (yellow) have been prepared form the corresponding oxides. By single crystal X-ray examination (precision technique, (100) and (001), Mo-K sub alpha), the structure of tetragonal KAgO has been elucidated: S(2)sub 4-I4, Z = 8, a = 9.91, c = 5.46 A; c/a = 0.55. The structure is characterized by square (Ag4O4) - groups; along (001) are infinite channels (diameter 2.5 A). According to Debye-Scherrer photographs CsAgO is isotopic with KAgO: A10.2 sub 5 A c = 6.17 A; c/a = 0.60. Author

**N72-21800*#** National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

**REFRACTORY DIELECTRIC SEMICONDUCTORS Patent Application**

Robert L. Trent, inventor (to NASA) Filed 1 Jul. 1970 17 p (NASA-Case-XER-08476-2; US-Patent-Appl-SN-60197) Avail: NTIS CSCL 20L

A process is described for making semiconductor devices having refractory dielectrics as diffusant masks and interconnection insulations. The refractory dielectric is deposited onto a semiconductor wafer and an aperture is created that extends through the dielectric to the wafer. An impurity is then diffused into the wafer at the aperture, and a semiconductor junction is created. Further junctions can be created by applying a second deposition of the refractory dielectric and then performing further aperture creating and impurity diffusing operations. Alternatively, a thermally grown dielectric can be grown in the first aperture and a second aperture can be created through the dielectric. A further impurity is then diffused into the wafer at the second aperture. NASA

**N72-21801#** Compagnie Francaise Thomson Houston-Hotchkiss Brandt, Paris. Lab. Central de Recherches.

**STUDY OF SEVERAL GUNN EFFECT OPERATION MODES [ETUDE DE CERTAINS REGIMES DE FONCTIONNEMENT EN EFFET GUNN]**

P. C. Moutou 3 Nov. 1970 139 p refs In FRENCH

(Contract DRME 68-34-481)

(Rept-1891; Rept-1891) Avail: NTIS

Studies comparing the Gunn effect operation with and without limited space charge accumulation (:SA) mode are reported. To overcome difficulties met during earlier work it was proposed that the LSA probes should be shortened to enable the device to work more like an amplifier. Shortening the probe admits some inhomogeneity in the material as the charges can be evacuated through the anode. It was also suggested that the diodes should be coupled in series to prevent a decrease of the power with increasing frequencies. In the present work microwave oscillations in gallium arsenide diodes were studied from the mean density of impurities and the volt-ampere characteristics. Equations for a one-dimensional model are presented. ESRO

**N72-21802#** Compagnie Francaise Thomson Houston-Hotchkiss Brandt, Paris. Lab. Central de Recherches.

**CHARACTERIZATION OF SEMICONDUCTOR MATERIALS Final report [CARACTERISATION DE MATERIAUX SEMICONDUCTEURS RAPPORT FINAL]**

M. Carballes, M. LeBailly, P. Leclerc, and P. Hirtz 20 Jul. 1970 88 p refs In FRENCH

(Contract DRME-68-34-778)

Avail: NTIS

Certain parameters of doped gallium arsenide were defined by considering the efficiency of band to band recombination (life duration of minority carriers); analyzing of impurity levels characterized by ionization energy, electron concentration and distribution in forbidden bands, and capture cross-sections; and homogeneity of surface layers of the material and in depth in the case of epitaxial layers, measured using either the cathode luminescence or trapped electrons. ESRO

**N72-21803#** Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.

**HIGH FREQUENCY VIBRATIONS OF PIEZOELECTRIC CRYSTAL PLATES**

R. D. Mindlin Jan. 1972 27 p refs

(Contracts DAAB07-72-C-0166; N00014-67-A-0108-0027; DA Proj. 1H6-62705-A-058)

(AD-735956; TR-8; TR-22) Avail: NTIS CSCL 09/1

Two dimensional equations of motion of piezoelectric crystal plates are obtained by retaining early terms of power series expansions of the mechanical displacement and electric potential in a variational principle for the three-dimensional equations of piezoelectricity. Author (GRA)

N72-21804# New Mexico Univ., Albuquerque. Bureau of Engineering Research.
**THE FABRICATION AND EXPERIMENTAL ANALYSIS OF METAL INSULATOR SEMICONDUCTOR DEVICES FOR RADIATION VULNERABILITY STUDIES**
T. A. Williamson and W. W. Grannemann Dec. 1971 271 p refs
(Contract N00014-68-A-0158)
(AD-735947; EE-193(71)ONR-005) Avail: NTIS CSCL 09/1

The report discusses the following: The insulated gate field effect transistor (IGFET); Nuclear radiation effects on the IGFET; The fabrication of metal-insulator-silicon (MIS) capacitors; Analysis of the MIS capacitor; Testing of experimental devices, and Analysis of the experimental data. GRA

N72-21805# IIT Research Inst., Chicago, Ill.
**EXCESS NOISE IN SEMICONDUCTORS Final Report, 5 Nov. 1965 - 14 Nov. 1971**
James J. Brophy 14 Nov. 1971 65 p refs
(Contract N00014-66-C-0032)
(AD-735944; IITRI-V6026-FR; A6145) Avail: NTIS CSCL 20/12

Several experimental studies of the statistical properties of I/f noise in semiconductors have shown that the probability amplitude distribution obeys a normal distribution law. The total variance of the distribution fluctuates in identical sample intervals. Variance fluctuations measured for several sources of I/f noise are not normally distributed and appear to be derived from an exponential population. The variance noise spectrum is examined by a combined analog-digital technique and it is found to have a I/f spectrum. The magnitude of I/f noise in germanium is shown to be inversely proportional to the number of current carriers participating in conduction. This inverse relation holds for both extrinsic carriers and photocarriers generated by optical illumination. Author (GRA)

N72-21806# Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy.
**ELECTRIC AND MAGNETIC SHIELDING WITH SUPERCONDUCTORS**
William O. Hamilton and Blas Cabrera 1971 20 p refs
(Grant AF-AFOSR-2054-71; AF Proj. 9767)
(AD-735396; AFOSR-72-0085TR) Avail: NTIS CSCL 20/3

Superconducting shielding offers the possibility of extremely high attenuation (shielding factors of 10 million) of time varying external fields from very low frequencies up to frequencies in the microwave region. The authors have demonstrated that it is also possible to obtain exclusion of steady external fields to the extent that a region 4 inches in diameter and several feet long had a field of less than 6 x 10 to the minus 8th power gauss. This type of shielding is not difficult to use in most low temperature apparatus. Author (GRA)

N72-21807# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
**THE APPLICATION OF GROUP THEORY TO THE CALCULATION OF THE INFLUENCE OF AN ELECTRIC RESONANCE SPECTRUM IN RUBY**
Zdzislaw Ozgo 3 May 1971 17 p refs Transl. into ENGLISH from Poznan. Towarz. Przyjaciol Nauk, Komisja Mat.-Przyrod. Prace (Poznan, Poland), v. 11, no. 3, 1966 p 689-697
(Contract N00017-62-C-0604)
(AD-735814; APL-CLB-3-T-637) Avail: NTIS CSCL 20/12

Group theory was used to study the effect of a homogeneous electric field on the EPR spectrum of ruby. By taking into consideration only geometrical symmetry and the symmetry connected with time reversal, the author was able to characterize the electric field effect by six constants. This result is in agreement with the experimental results of Royce and Bloembergen. GRA

N72-21808# Army Electronics Command, Fort Monmouth, N.J.
**PROCESSING TECHNIQUES FOR SHOCK RESISTANCE PRECISION QUARTZ CRYSTAL UNITS**
Heinz Wasshausen Dec. 1971 42 p
(DA Proj. S-662705-A-058)
(AD-735685; ECOM-3524) Avail: NTIS CSCL 09/1

Processing techniques were established for 20-22 MHz, plus or minus 3 ppm, 0C to 60C fundamental model quartz crystal units with tightly controlled equivalent circuit parameters and high shock resistance. Details for the processing techniques are presented, establishing means of assuring manufacturing repeatability, particularly during the more critical stages, e.g. edge conditioning of the crystal blanks, lapping and polishing to close tolerances, X-ray measurements, appropriate electroding and plateback, mounting and bonding procedures, frequency plating, bakeout cycle sealing procedures. Author (GRA)

# 27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N72-21809*# Aerojet Solid Propulsion Co., Sacramento, Calif.
**THE EFFECT OF SOLID PHASE REACTIONS ON THE BALLISTIC PROPERTIES OF PROPELLANTS**
Willered G. Schmidt Sep. 1970 76 p refs
(Contract NAS1-9463)
(NASA-CR-111940) Avail: NTIS CSCL 21I

The combustion of NH4ClO4 composite propellants has been studied between 15 and 3000 psi. The emphasis in the program has been on determining the mechanisms by which the fuel components influence the burning rate of the composites. In order to have flexibility in the choice and concentration of the fuel component all combustion experiments were performed with pressed power strands. The fuels studied included those which affected the combustion mechanism of the composite primarily through their effect on: (1) the oxidizer decomposition mechanism and (2) the composite surface temperature. The combustion of pure and doped NH4ClO4 was studied using both pressed powder strands and pressed end burning motor grains. The experimental approach has been essentially a chemical one with emphasis on perturbing those reactions which occur on or immediately adjacent to the surface (zone of influence) of the composite. Author

N72-21810# Institut fuer Chemie der Treibstoffe, Berghausen (West Germany).
**DETERMINATION OF STRAIN DEFORMATION BEHAVIOR OF SOLID PROPELLANTS WITH HIGH STRESSING VELOCITIES [BESTIMMUNG DES SPANNUNGS-VERFORMUNGS-VERHALTENS VON FESTTREIBSTOFFEN BEI HOHEN BEANSPRUCHUNGSGESCHWINDIGKEITEN]**
D. Schmitt 22 Dec. 1970 123 p refs In GERMAN
(ICT-10/70) Avail: NTIS

A survey of one-dimensional stress in solid propellants due to stress velocities in the range from + to - 0.5 m/sec is reported. A bibliography and a survey of available test devices are included. Tests with a pneumatically driven high-velocity tensile machine and related problems are analyzed, and relation of these tests to solid propellants is stressed. The work led to the writing of a specification for research work which is annexed to the report. ESRO

N72-21811# Air Force Rocket Propulsion Lab., Edwards AFB, Calif.
**LONG-TERM STORABILITY OF PROPELLANT TANKAGE**
Howard M. White Nov. 1971 116 p refs
(AF Proj. 30580)

(AD-735288; AFRPL-TR-71-113) Avail: NTIS CSCL 21/8

The report covers the testing of liquid rocket propellant tankage and propellant subsystems to evaluate their long-term storage characteristics. Author (GRA)

# 28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

**N72-21812#** General Dynamics Corp., San Diego, Calif. Convair Aerospace Div.

**ORBIT-TO-ORBIT SHUTTLE PROPELLANT INTEGRATION AND HANDLING STUDY Final Report, Jul. 1970 - Aug. 1971**

Daniel A. Heald, Gordon R. Stone, and Sam Kaye Edwards AFB, Calif. AFRPL 29 Dec. 1971 291 p refs

(Contract F04611-70-C-0087; AF Proj. 3058)

(AD-735290; GDC-BNZ70-013-18; AFRPL-TR-71-117) Avail: NTIS CSCL 21/9

The study examines the hazards inherent in the design and operation of ground and vehicle systems for a liquid fluorine space vehicle. The selected tanking system uses LN2 to preclude boiloff in the storage vessel and in the space vehicle propellant tank. Three possible emergency courses of action are provided in the system arrangement. It was concluded that a safe and practical ground fluorine system can be designed, avoiding technology problems, but paying particular attention to eliminate leak and reaction sources. Author (GRA)

**N72-21813#** Southwest Research Inst., San Antonio, Tex.

**INVESTIGATION OF THE EFFECTS OF TRACE METALS ON THE THERMAL STABILITY OF JP-7 FUELS Technical Report, 1 Dec. 1970 - 30 Nov. 1971**

Larry W. Schenk, Robert K. Johnston, and Charles M. Monita Wright-Patterson AFB, Ohio AFAPL Dec. 1971 38 p refs

(Contract F33615-69-C-1231; AF Proj. 3048)

(AD-736475; SWRI-RS-579; AFAPL-TR-71-98) Avail: NTIS CSCL 21/4

Experimental studies have shown that trace amounts of fuel-soluble metal compounds can be very detrimental to JP-7, a high-quality jet fuel. Adverse effects on fuel thermal stability have been demonstrated by gas-drive fuel coker tests on JP-7 fuels containing as little as 15 to 25 parts per billion of added iron or copper, or 100 to 250 parts per billion of added zinc or lead. The true threshold concentrations were generally lower, since the added metal tended to disappear from fuel samples during storage and handling. The ambiquities in metal content hinder any clear correlation and make it impractical to recommend metal-content limits for fuel quality control. GRA

**N72-21814#** Rocketdyne, Canoga Park, Calif.

**PHENOMENOLOGY OF SYNERGISTIC CATALYZED PROPELLANTS Final Technical Report, 1 Jun. 1970 - 30 Nov. 1971**

George D. Sammons Jan. 1972 137 p refs

(Contract N00014-70-C-0354; NR Proj. 092-538)

(AD-736222; R-4646-2) Avail: NTIS CSCL 21/9

Effectiveness of synergistic catalyst systems in altering ballistic parameters of composite solid propellants was studied and synergism observed in oxidizer decomposition by differential thermal analysis techniques was demonstrated in real propellant. Results of Keenan's work, that showed chlorides and various transition metal ions exhibit synergistic effect in catalysis of thermal decomposition of ammonium nitrate, were confirmed through differential scanning calorimetry and thermogravimetric analysis and were correlated with DSC results. Keenan's results indicating synergism were apparently partially the result of sample self-heating. Author (GRA)

**N72-21815*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**PROCEDURE FOR ESTIMATING EFFECTS OF ION BEAM INTERACTION WITH SPACECRAFT**

Thaine W. Reynolds Apr. 1972 19 p refs

(NASA-TM-X-68043; E-6880) Avail: NTIS CSCL 21C

Procedure for calculating various interactions of neutral and charged particle efflux from ion thrusters with spacecraft surfaces is outlined. Calculation details are referenced. Details of charge-exchange calculation in the near-field of the thruster are presented. Author

**N72-21816*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**OPTIMIZATION OF ENGINES FOR A COMMERCIAL MACH 0.98 TRANSPORT USING ADVANCED TURBINE COOLING METHODS**

Gerald A. Kraft and John B. Whitlow, Jr. Mar. 1972 71 p refs

(NASA-TM-X-68031; E-6848) Avail: NTIS CSCL 21A

A study was made of an advanced technology airplane using supercritical aerodynamics. Cruise Mach number was 0.98 at 40,000 feet altitude with a payload of 60,000 pounds and a range of 3000 nautical miles. Separate-flow turbofans were examined parametrically to determine the effect of sea-level-static design turbine-inlet-temperature and noise on takeoff gross weight (TOGW) assuming full-film turbine cooling. The optimum turbine inlet temperature was 2650 F. Two-stage-fan engines, with cruise fan pressure ratio of 2.25, achieved a noise goal of 103.5 EPNdB with todays noise technology while one-stage-fan engines, achieved a noise goal of 98 EPNdB. The take-off gross weight penalty to use the one-stage fan was 6.2 percent.

Author

**N72-21817*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**PERFORMANCE AND CONTROL STUDY OF A LOW-PRESSURE-RATIO TURBOJET ENGINE FOR A DRONE AIRCRAFT**

Kurt Seldner, Lucille C. Geyser, Harold Gold, Darrel Walker, and Gary Burgner Apr. 1972 55 p refs

(NASA-TM-X-2537; E-6688) Avail: NTIS CSCL 21E

The results of analog and digital computer studies of a low-pressure-ratio turbojet engine system for use in a drone vehicle are presented. The turbojet engine consists of a four-stage axial compressor, single-stage turbine, and a fixed area exhaust nozzle. Three simplified fuel schedules and a generalized parameter fuel control for the engine system are presented and evaluated. The evaluation is based on the performance of each schedule or control during engine acceleration from a windmill start at Mach 0.8 and 6100 meters to 100 percent corrected speed. It was found that, because of the higher acceleration margin permitted by the control, the generalized parameter control exhibited the best dynamic performance. Author

**N72-21818#** Joint Publications Research Service, Arlington, Va.

**STRENGTH OF CAST GAS TURBINE BLADES UNDER VARIABLE LOADS**

T. P. Zakharova and B. F. Balashov 28 Mar. 1972 13 p Transl. into ENGLISH from Probl. Prochnosti (Kiev), no. 7, Jul. 1971 p 55-61

(JPRS-55555) Avail: NTIS

The mechanical properties of cast turbine blades under variable load conditions are discussed. It is determined that variable loads applied to a cast alloy with high structural heterogeneity cause areas of concentrated plastic deformation and stress. When an asymmetric cycle of variable stresses is applied, the ability of the field of stresses in areas of stress concentration depends on plastic deformation and the creep of the material. Procedures for conducting fatigue tests of turbine blades are described. Author

**N72-21819*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**TECHNICAL EVALUATION REPORT ON PROPULSION AND ENERGETICS PANEL 38TH MEETING ON INLETS AND NOZZLES FOR AEROSPACE ENGINES**

David N. Bowditch and Rodolfo Monti (Naples Univ.) Paris AGARD Feb. 1972 6 p refs

(NASA-TM-X-67741; AGARD-AR-41) Avail: NTIS CSCL 21A

The application and use of inlets and nozzles in aerospace, V/STOL, and hypersonic propulsion systems are discussed. Data cover test techniques and facilities, experimental results from small rig tests to flight tests, and theoretical analysis of propulsion system flows. The problems associated with such a system are also discussed. E.H.W.

**N72-21820*#** TRW Systems Group, Redondo Beach, Calif.

**MONOPROPELLANT HYDRAZINE RESISTOJET MODEL SPECIFICATION Task Summary Report**

Rein Grabbi Feb. 1972 64 p

(Contract NAS5-11477)

(NASA-CR-122377; TRW-20266-6010-R0-00) Avail: NTIS CSCL 21H

The specifications for the electrothermal hydrazine thruster model are presented including performance, design and qualification requirements, and product configuration and acceptance tests. The contamination control procedures, acceptance test plan, and engineering drawings are included. F.O.S.

**N72-21821*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**SINGLE GRID ACCELERATOR SYSTEM Patent Application**

Paul M. Margosian and Shigeo Nakanishi, inventors (to NASA) Filed 14 Sep. 1971 9 p

(NASA-Case-XLE-10453-2; US-Patent-Appl-SN-180473) Avail: NTIS CSCL 21C

A single grid accelerator system is described for an ion thrustor. A layer of dielectric material is interposed between the metal grid and the chamber containing an ionized propellant for protecting the grid against sputtering erosion. NASA

**N72-21822#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Thermogasdynamik.

**USE OF ALUMINUM ALKYLS AS FUEL OR FUEL ADDITIVE FOR SUPERSONIC COMBUSTION [UEBER DIE ANWENDUNG DER ALUMINIUMALKYLE ALS KRAFTSTOFF ODER KRAFTSTOFFZUSATZ FUER DIE UEBERSCHALLVERBRENNUNG]**

Michael Kallergis, Manfred Ahlswede, and Gerhard Grosse 1971 28 p refs In GERMAN: ENGLISH summary

(DLR-Mitt-71-26) Avail: NTIS; DFVLR, Porz 8,50 DM

The effects of heat addition on the rearward facing surface of a hypersonic vehicle is discussed. The heat is furnished by the external combustion of a pyrophoric fuel (TEA). Subjects presented are: (1) some theoretical calculations, (2) a description of the hot water ejector wind tunnel test facility, (3) the model of the hypersonic vehicle, and (4) the metering device for the pyrophoric fuel. Author (ESRO)

**N72-21823#** Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.

**MICRO-ROCKET IMPULSIVE THRUSTERS Final Report**

Leonard H. Caveny and Martin Summerfield Nov. 1971 116 p refs

(Contract DAHC60-71-C-0034)

(AD-735381; AMS-1014) Avail: NTIS CSCL 21/8

Light weight solid propellant motors which supply high thrusts (greater than 500 lbf) for durations on the order 0.010 sec. (referred to as impulsive thrusters) require special analysis of items such as internal ballistics, propellant combustion, ignition stimuli, exhaust plume envelope, and inert hardware. A survey of the rocket motor concepts revealed that the desired thrust versus time program can be achieved by internal burning grains and existing high burning rate composite propellants. The mathematical model for transient internal ballistics developed during the study can be applied to a wide range of high performance rocket motors which experience rapid ignition and pressurization transients. Author (GRA)

**N72-21824#** TRW Systems Group, Redondo Beach, Calif.

**PULSED ELECTROMAGNETIC THRUSTER Final Report**

C. L. Dailey Dec. 1971 78 p refs

(Contract F33615-71-C-1032)

(AD-735721; AFRPL-TR-71-107) Avail: NTIS CSCL 21/3

A pulsed inductive plasma thruster has been developed and its performance investigated experimentally. The thruster uses a 20 cm diameter coil through which current is pulsed by discharging a capacitor through a spark gap. Gaseous propellant is injected by a fast acting valve having a total open time of 200 microseconds. The mass utilization factor for this injector was 70 percent. The efficiencies determined by a thrust balance were lower than anticipated because of a large resistive dissipation. Author (GRA)

**N72-21825#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**THEORETICAL INVESTIGATION OF OSCILLATORY BLADE ROW AERODYNAMICS UNDER UNSTALLED CONDITIONS**

J. Stern 28 Oct. 1971 34 p Transl. into ENGLISH from Strojnicky Cas. (Czechoslovakia), v. 21, no. 3, 1970 p 265-287

(FSTC Proj. 6040102)

(AD-735205; FTD-HC-23-862-71) Avail: NTIS CSCL 21/5

In order to calculate the critical flutter-speed of compressor and turbine blade systems, it is necessary to carry out the numerical determination of the oscillatory aerodynamic forces and moments acting on a cascade of aerofoils. The object of this paper is to give a method for calculating these oscillatory lifts and moments for the case of an infinite, two-dimensional cascade at non-zero incidence. Arbitrary stagger and interblade phase-lag angles are permitted. The blades are supposed to be flat plates undergoing oscillatory motion consisting of flexural and torsional degrees of freedom. This paper presents a natural extension of the Whitehead method to the more general case, in which the aerodynamics of cascade blades under bending-torsion oscillation is treated. Author (GRA)

**N72-21826#** Air Force Rocket Propulsion Lab., Edwards AFB, Calif.

**HOT DESTRUCT TEST OF THE THIRD-STAGE ATHENA/H SOLID ROCKET MOTOR Technical Report, 27 Feb. - 23 Apr. 1971**

R. M. Seibel, III and C. P. Price, III Nov. 1971 33 p ref

(AF Proj. 627 AOO-AMT)

(AD-735289; AFRPL-TR-71-116) Avail: NTIS CSCL 19/1

The Athena Destruct Test was conducted at the Air Force Rocket Propulsion Laboratory on 22 April 1971 with a third-stage Athena/H (Alcor JB/23KS11000) solid propellant rocket motor. The objective of the test was to demonstrate that the Third-Stage Athena/H destruct hardware would terminate the thrust of a burning Alcor IB motor without resulting in 'high-order' detonation. A secondary test objective was to attempt estimating the initial velocities of debris and fragments using high-speed

photography. All test objectives were successfully accomplished. Author (GRA)

**N72-21827#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**IMPROVEMENT OF THE CALCULATION OF MULTISTAGED TURBINES OF GAS TURBINE ENGINES**
V. A. Strunkin 9 Nov. 1971 13 p refs Transl. into ENGLISH from Tr. Aviats. Inst. (Kazan), no. 115, 1969 p 41-46
(FTD Proj. 3066)
(AD-736489; FTD-MT-24-1453-71) Avail: NTIS CSCL 21/5

The extension of the author's single stage gas turbine improved designing technique (1969) to the calculation of parameters in multistage gas turbine designs is shown. Expressions and nomograms are given for the translation of the previous results to multistage turbine parameter and component analysis and selection. Optimized turbine stage, geometrical characteristics, blade and wheel parameters and multistage gas turbine efficiencies can be determined by using these expressions in computer calculations. Author (GRA)

**N72-20983*#** National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
**TECHNIQUES FOR THE EVALUATION OF AIR-BREATHING PROPULSION SYSTEMS IN FULL-SCALE FLIGHT**
Donald R. Bellman, Frank W. Burcham, Jr., and Norman V. Taillon *In* AGARD Flight Test Tech. Feb. 1972 15 p refs (See N72-20976 12-02)
(NASA-TM-X-68305) Avail: NTIS CSCL 21A

# 29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation, and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

**N72-21828*#** Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
**DIRECT OBSERVATIONS OF LOW-ENERGY SOLAR ELECTRONS ASSOCIATED WITH A TYPE 3 SOLAR RADIO BURST**
L. A. Frank and D. A. Gurnett Feb. 1972 54 p refs
(Contracts NAS5-11039; NAS5-11074; Grant NGL-16-001-002; Contract N00014-68-A-0196-0003)
(NASA-CR-125932; U-of-Iowa-72-2) Avail: NTIS CSCL 03B

On 6 April 1971 a solar X-ray flare and a type 3 solar radio noise burst were observed with instrumentation on the eccentric-orbiting satellite IMP 6. The type 3 solar radio noise burst was detected down to a frequency of 31 kHz. A highly anisotropic packet of low-energy solar electron intensities arrived at the satellite approximately 6000 seconds after the onset of the solar flare. This packet of solar electron intensities was observed for 4200 seconds. Maximum differential intensities of the solar electrons were in the energy range of one to several keV. The frequency drift rate of the type 3 radio noise at frequencies below 178 kHz also indicated an average particle speed corresponding to that of a 3-keV electron. The simultaneous observations of these solar electron intensities and of the type 3 solar radio burst are presented, and their interrelationships are explored. Author

**N72-21829*#** Smithsonian Astrophysical Observatory, Cambridge, Mass.
**ANALYSIS OF SOLAR ULTRAVIOLET LINES**
Eric Chipman 15 Sep. 1971 193 p refs
(Contract NAS5-9274; Grant NGR-22-007-211)
(NASA-CR-125981; SAO-Special-Rept-338) Avail: NTIS CSCL 03B

The formation of the strongest ultra-violet emission lines of Mg II, O I, C II, and C III in the solar atmosphere is studied in detail. The equations of statistical equilibrium and radiative transfer for each ion are solved using a general computer program that is capable of solving non-LTE line-formation problems for arbitrary atmospheric and atomic models. Interpreting the results in terms of the structure of the solar atmosphere, it is concluded that the HSRA atmosphere has a temperature too low by about 500 K near h = 1100 km and that a temperature plateau with T sub e approximately = 18,000 K and width close to 60 km exists in the upper chromosphere. The structure of the solar atmosphere in the range 20,000 to 100,000 K and the effects of microturbulence on the formation of lines are also investigated. Approximate analytic line-formation problems are solved, and more exact solutions are derived later. An attempt is made to make the best possible fit to the Ca II K line center-to-limb profiles with a one-component atmosphere, with an assumed source function and microturbulent velocity. Author

**N72-21830#** Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
**HOT UNIVERSE, COSMIC RAYS OF ULTRAHIGH ENERGY AND ABSOLUTE REFERENCE SYSTEM**
Humitaka Sato and Takao Tati Jan. 1972 8 p refs
(RIFP-142) Avail: NTIS

The critical discrepancy between theory and observation on the existence or nonexistence of a strong attenuation effect on cosmic rays in the vicinity of 10 to the 20th power eV is investigated. A hypothesis is proposed which consists of the following: (1) All inertial systems are not equivalent and there exists a universal time-like unit vector for an N-system. (2) Production of hadrons at high-energy collision is suppressed when their momenta in the N-system become larger than some critical value. It is shown that the relation between hadron momenta and the critical value is such that ultrahigh energy cosmic rays are free from the attenuation due to hadron production. N.E.N.

**N72-21831*#** Bell Telephone Labs., Inc., Murray Hill, N.J. Radiation Physics Research Dept.
**REDUCTION AND ANALYSIS OF PARTICLE DATA FROM IMP F (EXPLORER 34) AND IMP G (EXPLORER 41) Final Report, Jun. 1965 - Dec. 1971**
W. L. Brown 31 Dec. 1971 249 p refs
(Contract NAS5-9102)
(NASA-CR-122389) Avail: NTIS CSCL 03B

This report consolidates material prepared by investigators who participated in the analysis of particle data acquired by particle detection equipment on Explorer 34 and Explorer 41 satellites. Results of studies concern the propagation and composition of solar flare particles measured in the interplanetary space by the two satellites. For individual titles, see N72-21832 through N72-21848.

**N72-21832*#** Bell Telephone Labs., Inc., Murray Hill, N.J.
**A SATELLITE SOLAR COSMIC RAY SPECTROMETER WITH ON-BOARD PARTICLE IDENTIFICATION**
L. J. Lanzerotti, H. P. Lie, and G. L. Miller *In its* Reduction and Analysis of Particle Data from IMP F (Explorer 34) and IMP G (Explorer 41) 31 Dec. 1971 8 p refs (See N72-21831 12-29)
Avail: NTIS CSCL 03B

The design and calibration results of a satellite based solar cosmic ray particle identifier system utilizing a field effect transistor analog multiplier for the IMP F and G spacecraft are described. A discussion is made of the effectiveness of particle separation by such a particle identifier used in onboard data processing. Author

**N72-21833*#** Bell Telephone Labs., Inc., Murray Hill, N.J.
**PENETRATION OF SOLAR PROTONS AND ALPHAS TO THE GEOMAGNETIC EQUATOR**

L. J. Lanzerotti *In its* Reduction and Analysis of Particle Data from IMP F (Explorer 34) and IMP G (Explorer 41) 31 Dec. 1971 5 p refs (See N72-21831 12-29)
Avail: NTIS CSCL 03B

Simultaneous spectral observations of low energy solar particle in interplanetary space by IMP-F and in the magnetosphere on the equator by ATS-1 strongly imply that these particles have essentially free access to the outer magnetosphere through a very effective diffusion mechanism which preserves the spectral shapes and the flux magnitudes. These observations further imply that measurements of solar particle arrival time over the polar caps are not sufficient to distinguish between open or closed magnetosphere models. Author

**N72-21834*#** Bell Telephone Labs., Inc., Murray Hill, N.J.
**PENETRATION OF SOLAR PARTICLES TO IONOSPHERIC HEIGHTS AT LOW LATITUDES**
L. J. Lanzerotti and T. E. Graedel *In its* Reduction and Analysis of Particle Data from IMP F (Explorer 34) and IMP G (Explorer 41) 31 Dec. 1971 2 p refs (See N72-21831 12-29)
Avail: NTIS CSCL 03B

The ionospheric and solar evidence presented by the Calcutta group has been examined and it was concluded that there is little basis for their contention that solar particles can penetrate directly to low altitudes and thus influence ionospheric absorption at the equator. Author

**N72-21835*#** Bell Telephone Labs., Inc., Murray Hill, N.J.
**PENETRATION OF SOLAR PROTONS INTO THE MAGNETOSPHERE AND MAGNETOTAIL**
L. J. Lanzerotti, M. D. Montgomery (Los Alamos Sci. Labs.), and S. Singer (Los Alamos Sci. Lab.) *In its* Reduction and Analysis of Particle Data from IMP F (Explorer 34) and IMP G (Explorer 41) 31 Dec. 1971 6 p refs (See N72-21831 12-29)
Avail: NTIS CSCL 03B

Three sets of satellite measurements were used to compare solar proton fluxes in the magnetotail, in the outer magnetosphere, at synchronous altitude, and in interplanetary space. Comparisons of the interplanetary and magnetosphere proton fluxes show that outer magnetosphere disturbances play a strong role in the initial access of near-90 deg pitch angle protons to synchronous altitude. One comparison of the magnetotail and synchronous altitude fluxes suggests that the synchronous altitude fluxes may not always result from a scattering of the protons in from the tail. The interplanetary magnetotail proton comparisons further confirm the results of Montgomery and Singer (1969), who found that delays in the proton access to the magnetotail were always present. Author

**N72-21836*#** Bell Telephone Labs., Inc., Murray Hill, N.J.
**ACCESS OF SOLAR PARTICLES TO SYNCHRONOUS ALTITUDE**
L. J. Lanzerotti *In its* Reduction and Analysis of Particle Data from IMP F (Explorer 34) and IMP G (Explorer 41) 31 Dec. 1971 23 p refs (See N72-21831 12-29)
Avail: NTIS CSCL 03B

When a source of solar originated particles is present in interplanetary space, comparable fluxes of these particles with similar spectral characteristics are usually observed inside the magnetosphere at synchronous altitudes. The temporal and spectral changes in the access of these solar protons and alpha particles to synchronous altitude are discussed and reviewed. Possible consequences of the presence of substantial fluxes of low energy solar protons deep inside the magnetosphere are also discussed. Author

**N72-21837*#** Bell Telephone Labs., Inc., Murray Hill, N.J.
**RAPID ACCESS OF SOLAR ELECTRONS TO THE POLAR CAPS**
J. P. Turtle (AFCRL, Bedford, Mass.), E. J. Oelbermann, Jr. (Pa. State Univ., Univ. Park), J. B. Blake (Aerospace Corp., El Segundo, Calif.), L. J. Lanzerotti, A. L. Vampola (Aerospace Corp., El Segundo, Calif.), and G. K. Yates (AFCRL, Bedford, Mass.) *In its* Reduction and Analysis of Particle Data from IMP F (Explorer 34) and IMP G (Explorer 41) 31 Dec. 1971 17 p refs (See N72-21831 12-29)
(Contract F04701-69-C-0066)
Avail: NTIS CSCL 03B

Simultaneous measurement of solar electrons and protons in interplanetary space and in the magnetotail were made during the onset of the 2 November 1969 solar particle event. These particle measurements, when compared with continuous trans-polar VLF measurements on three propagation paths, indicate the solar electrons have access to the magnetotail and north polar cap with a time delay within approximately one minute. Author

**N72-21838*#** Bell Telephone Labs., Inc., Murray Hill, N.J.
**LOW-ENERGY SOLAR PROTONS AND ALPHAS AS PROBES OF THE INTERPLANETARY MEDIUM: THE 28 MAY 1967 SOLAR EVENT**
L. J. Lanzerotti *In its* Reduction and Analysis of Particle Data from IMP F (Explorer 34) and IMP G (Explorer 41) 31 Dec. 1971 18 p refs (See N72-21831 12-29)
Avail: NTIS CSCL 03B

The low energy solar protons and alpha particles detected during the May 28 (day 148) 1967, solar flare were used as probes to investigate the properties of the interplanetary medium during the course of the event. The lower energy fluxes exhibit characteristics of particle storage either at the sun or in interplanetary space. The higher energy particles fluxes exhibit classical west limb flare profiles and were fit both to a simple isotropic diffusion-with-boundary model and to a radial dependent scattering center model. The diffusion coefficient model of Jokipii was used with the results of a fit to the exponential decay of the event to predict a frequency dependence of the power spectral density of the interplanetary magnetic field fluctuations (assuming a boundary location independent of rigidity). The ratio of particle fluxes before and after a sudden, discontinuous flux decrease (attributed to a sector boundary) was found to be approximately R3 for protons and approximately R6 for alphas for particles with rigidities less than or approximately 200 Mv. Significant velocity dispersions were discovered in three of the flux modulations during the onset stage of the event. The velocity dispersions in one of these modulations could be interpreted as due to a modulating region located approximately 0.03 AU from the earth. It is speculated that this region was responsible for an sc at the earth some two hours later. Author

**N72-21839*#** Bell Telephone Labs., Inc., Murray Hill, N.J.
**DISCUSSION OF PAPER, "A COMPARISON OF ENERGETIC STORM PROTONS TO HALO PROTONS"**
L. J. Lanzerotti *In its* Reduction and Analysis of Particle Data from IMP F (Explorer 34) and IMP G (Explorer 41) 31 Dec. 1971 3 p refs (See N72-21831 12-29)
Avail: NTIS CSCL 03B

Based on low energy solar particle data from an experiment on Explorer 34 for two of the May 1967 events, it was concluded that these two events described by Kahler do not fit his contention that energetic storm particles and halo particles have similar origins except that both sets of particles orginally eminated from the sun. It is believed that there are interplanetary processes operative on these solar particles to produce the energetic storm particles. The understanding of these processes is still at a rudimentary stage. Author

**N72-21840*#** Bell Telephone Labs., Inc., Murray Hill, N.J.
**SOLAR FLARE ALPHA TO PROTON RATIO CHANGES FOLLOWING INTERPLANETARY DISTURBANCES**
L. J. Lanzerotti and M. F. Robbins *In its* Reduction and Analysis of Particle Data from IMP F (Explorer 34) and IMP G (Explorer 41) 31 Dec. 1971 7 p refs (See N72-21831 12-29)
Avail: NTIS CSCL 03B

A discussion is presented on the half hour averaged low energy solar alpha to solar proton flux ratios observed following

the three large solar flares of May 23, 1967. One of the large changes observed in the particle ratios (following a sudden commencement (SC) storm observed on the earth) was interpreted as due to a source effect. The second large change, again observed following an SC, was observed in the equal velocity and equal rigidity ratios and not in the equal energy/charge ratios. This observation suggests that electric fields in an interplanetary disturbance may be the cause of the modulations. Author

N72-21841*# Bell Telephone Labs., Inc., Murray Hill, N.J.
**RELATIVE IMPORTANCE OF SOLAR ELECTRONS, PROTONS, AND ALPHAS IN THE NOVEMBER 1969 PCA EVENT**
L. J. Lanzerotti and C. G. Maclennan *In its* Reduction and Analysis of Particle Data from IMP F (Explorer 34) and IMP G (Explorer 41) 31 Dec. 1971 38 p refs Presented at COSPAR Symp. on Nov. 1969 Solar Particle Event, 16-18 Jun. 1971 (See N72-21831 12-29)
Avail: NTIS CSCL 03B

The fluxes of electrons, protons, and alpha particles produced by the 2 November 1969 west limb flare were measured in interplanetary space by a semiconductor particle telescope on the Explorer 41 satellite. Intense fluxes of electrons arrive at the earth approximately 1 hour after the flare and prior to the arrival of the higher energy protons. Calculations indicate that these electrons produce approximately fifty percent of the intense (approximately 14 dB) riometer absorption observed near the beginning of the event. The calculated electron and proton total riometer absorption agrees well throughout most of the event with that measured at 30 MHz at McMurdo, Antarctica. The alpha-to-proton ratios are presented for several different values of particle energy-per-nucleon. These ratios are quite low and indicate that the alphas were relatively insignificant contributors to the ionization of the PCA event. Author

N72-21842*# Bell Telephone Labs., Inc., Murray Hill, N.J.
**SOLAR PROTONS AND ALPHAS FROM THE 23 MAY 1967 SOLAR FLARES**
L. J. Lanzerotti *In its* Reduction and Analysis of Particle Data from IMP F (Explorer 34) and IMP G (Explorer 41) 31 Dec. 1971 12 p refs (See N72-21831 12-29)
Avail: NTIS CSCL 03B

The low energy protons and alpha particles emitted during a series of three east limb solar flares on May 23, 1967 were measured in interplanetary space by an experiment onboard Explorer 41. The time history of the solar particle observations made by the experiment are described and the particle fluxes and spectra associated with the storm sudden commencements and the onset of the large Forbush decrease observed on the earth are discussed. Author

N72-21843*# Bell Telephone Labs., Inc., Murray Hill, N.J.
**INTERPLANETARY PROTONS AND ALPHAS: 300-313, 1968**
L. J. Lanzerotti and C. M. Soltis *In its* Reduction and Analysis of Particle Data from IMP F (Explorer 34) and IMP G (Explorer 41) 31 Dec. 1971 7 p refs (See N72-21831 12-29)
Avail: NTIS CSCL 03B

The period in late October and early November, 1968, represented an interval of time when the interplanetary medium was quite disturbed and heavily populated with low energy solar protons. The solar flare-produced disturbances in the solar wind caused at least five large sudden commencements (SC) to be recorded in the earth during the seven days from October 26 through November 1. Interplanetary measurements were made by experiment on the Explorer 34 satellite. The experiment consisted of a four element solid state telescope oriented perpendicular to the spin axis. The half angle of the detector telescope defining collimator was 20 deg; the flux measured by the experiment was the spin averaged flux of particles in the ecliptic plane. Protons and alphas up to an energy of approximately 4 MeV/nucleon were distinguished by the energy deposited in the first two detectors of the telescope and subsequently measured in a five channel analyzer. Particle species above this energy were distinguished by the use of an onboard pulse multiplier. Author

N72-21844*# Bell Telephone Labs., Inc., Murray Hill, N.J.
**PROTONS, ALPHA PARTICLES, AND ELECTRONS RESULTING FROM THE 18 NOVEMBER 1968 SOLAR FLARE**
L. J. Lanzerotti *In its* Reduction and Analysis of Particle Data from IMP F (Explorer 34) and IMP G (Explorer 41) 31 Dec. 1971 6 p refs (See N72-21831 12-29)
Avail: NTIS CSCL 03B

Data are presented on the solar proton, alpha particles, and electron fluxes measured by an instrument on the Explorer 34 satellite following the extreme west hemisphere (N21 W87) 1B solar flare of November 18, 1968. The data measurements are described. Author

N72-21845*# Bell Telephone Labs., Inc., Murray Hill, N.J.
**INTERPLANETARY-PARTICLE ASSOCIATIONS WITH TYPE 3 SOLAR BURSTS**
T. E. Graedel and L. J. Lanzerotti *In its* Reduction and Analysis of particle data from IMP F (Explorer 34) and IMP G (Explorer 41) 31 Dec. 1971 7 p refs (See N72-21831 12-29)
Avail: NTIS CSCL 03B

Interplanetary proton and electron data from May 28 to November 30, 1967, were used to study the association of particle data with solar radio burst data in the dekametric band from OGO 3 and with data reported in Solar Geophysical Data and the I.A.U. Quarterly Bulletin. By using reasonable particle and radio burst association criteria, it was concluded that the observed associations during this time period do not support the common belief that interplanetary-particle observations confirm the association of electrons with type 3 radio bursts. Author

N72-21846*# Bell Telephone Labs., Inc., Murray Hill, N.J.
**ENHANCED ABUNDANCES OF LOW ENERGY HEAVY ELEMENTS IN SOLAR COSMIC RAYS**
L. J. Lanzerotti, C. G. Maclennan, and T. E. Graedel *In its* Reduction and Analysis of Particle Data from IMP F (Explorer 34) and IMP G (Explorer 41) 31 Dec. 1971 13 p refs (See N72-21831 12-29)
Avail: NTIS CSCL 03B

Measurements of solar cosmic ray O/He, Si/He, and Fe/He ratios during the onset phase of the 25 January 1971 flare event indicated a substantial (20-40 times) enhancement of the ratios above the solar photospheric abundances. It is suggested that preferential acceleration of the heavy elements within the solar flare region is the most likely cause of the increased abundances. Author

N72-21847*# Bell Telephone Labs., Inc., Murray Hill, N.J.
**SOLAR PROTON RADIATION DAMAGE OF SOLAR CELLS AT SYNCHRONOUS ALTITUDES** c03
L. J. Lanzerotti *In its* Reduction and Analysis of Particle Data from IMP F (Explorer 34) and IMP G (Explorer 41) 31 Dec. 1971 2 p refs (See N72-21831 12-29)
Avail: NTIS CSCL 10A

Experimental measurements of low energy solar protons and alpha particles at synchronous orbit show that the fluxes and spectra of these particles are in general quite similar to the solar particle observations made simultaneously in interplanetary space. Although the mechanisms responsible for the rapid appearance of these particles into the outer magnetosphere are not yet understood, the mere presence at synchronous altitude of a moderate flux of 1-MeV protons for several days can be the dominate damage mechanism for unshielded solar cells. These particle observations also explain the abnormal damage to unshielded solar cells discovered by the solar cell experiment on ATS-1. Solar particle enhancement measurements show the significance of even moderate solar fluxes at synchronous altitudes for radiation damage considerations. Author

N72-21848*# Bell Telephone Labs., Inc., Murray Hill, N.J.
**SOLAR FLARE PARTICLE RADIATION**
L. J. Lanzerotti *In its* Reduction and Analysis of Particle Data from IMP F (Explorer 34) and IMP G (Explorer 41) 31 Dec. 1971 58 p refs Presented at the Natl. Symp. on Nat. and Manmade Radiation in Space, 1-4 Mar. 1971 (See N72-21831 12-29)
Avail: NTIS CSCL 03B

A review of the solar flare particle time dependence, composition, spectra, and propagation characteristics as observed at the earth is presented. Representative examples of ground and spacecraft observations of flare protons, alphas, and electrons are discussed. Differences in the time dependences of these particle fluxes after a flare as a function of particle energy and flare location are indicated. At very low energies (approximately 1-10 MeV), the effects of convection by the solar wind apparently produce an approximately energy-independent decay time for post-flare particle fluxes that exhibit a diffusive temporal profile. Effects of solar flare particles at the earth in producing polar cap riometer absorption and in producing spacecraft solar cell damage at the synchronous altitude are also briefly outlined. Author

N72-21849# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.
**COSMIC RAY NM-64 NEUTRON MONITOR DATA 19: MONTHLY GRAPHS, MAY - AUGUST 1971**
J. F. Steljes Oct. 1971 71 p
(AECL-4060) Avail: AEC Depository Libraries; Atomic Energy of Can., Ltd., Chalk River: $2.00

Uncorrected and barometer-corrected results from the cosmic ray stations in Canada are given in tabular form for the period from May to August 1971. Normalized graphs are given for the same period. Correction factors for the constant rates of drift of the barometers at each of the four stations are given. A small flare increase occurred on 1-2 September 1971. Author (NSA)

N72-21850# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
**COSMIC RAY NEUTRON AND MUON MONITOR DIURNAL VECTORS. 7: FROM THE START OF SOLAR ROTATION NO. 1867 TO THE END OF SOLAR ROTATION NO. 1879 (17 JANUARY 1970 TO 2 JANUARY 1971) AND VECTOR DIAGRAMS BY SOLAR ROTATION**
John F. Steljes Oct. 1971 121 p
(AECL-4059) Avail: AEC Depository Libraries; AECL $2.50

Daily diurnal and semidiurnal variation vectors for both the muon and the neutron monitors at four cosmic-ray stations in Canada are given in tabular form for the period from the start of solar rotation No. 1867 to the end of rotation No. 1879. The same vectors for the AECL neutron and muon monitors at Kula, Hawaii, and for the Bolivian neutron monitor at Chacaltaya are also given. The vectors were corrected for barometer and in the case of the muons, except at Kula, for the atmospheric temperature wave using hourly values of the temperature and barometric pressure measured near the ground. Graphs of the vectors at each station for successive solar rotations are also given. Author (NSA)

N72-21851# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
**WEAKLY-SHOCKED FLOWS OF THE SOLAR WIND PLASMA THROUGH ATMOSPHERES OF COMETS AND PLANETS**
Max Wallis Jan. 1972 27 p refs Submitted for publication Sponsored by UK Sci. Res. Council
(TRITA-EPP-72-02) Avail: NTIS

The quasi-one-dimensional continuum description of the solar wind ionizing interaction with neutral atmospheres was employed to yield solutions to problems of upstream transonic flow. Subsonic flow was approximated by assuming constant total energy flux. Shocked solutions were found for problems of mass-accreting flows. These solutions can be extended to shock-free solutions for low gradients in the ionization rate. Author (ESRO)

N72-21852# TRW Systems Group, Redondo Beach, Calif.
**ANALYSIS OF SOLAR X-RAY DATA FROM THE OV5-1 (1967-40E) Final Report, 15 Jan. 1968 - 15 Jun. 1971**
Robert E. Fortney 16 Jun. 1971 56 p ref
(Contract F19628-68-C-0253; AF Proj. 8666)
(AD-735277; TRW-09865-6002-R0-00; AFCRL-71-0470) Avail: NTIS CSCL 04/1

The material presented in the document includes: (1) Geiger-Mueller tube count rates outside the magnetosphere as related to smoothed sunspot number, (2) differential solar proton spectra for the 23 May 1967 solar event and (3) the response of several instruments while crossing the magnetosphere boundary. Author (GRA)

N72-21853# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory.
**COUNTS OF INTENSE EXTRAGALACTIC RADIO**
A. H. Bridle, M. M. Davis, E. B. Fomalont, and J. Lequeux 1971 19 p refs
(Contract N00014-67-A-0094-0019; Grant NSF GP-304)
(AD-734377; Rept-1971-16) Avail: NTIS CSCL 03/2

The counts of discrete extragalactic radio sources at different levels of flux density, and their interpretation in terms of cosmological models, have been the subject of controversy for nearly fifteen years. Much discussion has centered on determinations of the exponent gamma of the number-flux density relation N(S) proportional to (S to the -gamma power), where N is the number of sources per steradian whose flux densities exceed S. Counts derived from surveys at frequencies below 500 MHz have indicated that gamma = 1.5 for the intense sources. In this paper the authors derive counts from accurate 1400 MHz observations of intense sources over a large area of the sky. It is shown that there is little evidence for cosmological evolution contingent on gamma = 1.5 for these sources, but that separation of the counts according to the surface brightness of the sources may lead to a cosmologically significant result. Author (GRA)

N72-21854# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory.
**HIGH RESOLUTION RADIO OBSERVATIONS OF THE GALACTIC CENTER**
R. D. Ekers and D. Lynden-Bell 1971 17 p refs Submitted for publication
(Contract N00014-67-A-0094-0019; Grant NSF GP-30400)
(AD-734376; Rept-1971-15) Avail: NTIS CSCL 03/2

5 GHz interferometric observations with a resolution of 6 sec x 18 sec arc indicate the presence of compact components in Sagittarius A and in some of the other radio sources in the galactic center region. Author (GRA)

N72-21855# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
**RAPID ACCESS OF SOLAR ELECTRONS TO THE POLAR CAPS Report for Jul. - Aug. 1971**
John P. Turtle (AFCRL), G. K. Yates (AFCRL), E. J. Elberman, Jr. (Pa. State Univ.), J. Bernard Blake, Alfred L. Vampola, and L. J. Lanzerotti (Bell Telephone Labs.) 15 Dec. 1971 23 p refs
(Contract F04701-71-C-0172)
(AD-736430; TR-0172(2260-20)-11; SAMSO-TR-71-318) Avail: NTIS CSCL 04/1

Simultaneous measurement of solar electrons and protons in interplanetary space and in the magnetotail were made during the onset of the 2 November 1969 solar particle event. These particle measurements, when compared with continuous trans-polar VLF measurements on three propagation paths, indicate the solar electrons have access to the magnetotail and north polar cap with a time delay t and such that 0 less than or equal to t less than 1 min. Author (GRA)

**N72-21124#** Imperial Coll. of Science and Technology, London (England). Physics Dept.
**THE POLAR EXOSPHERIC PLASMA**
J. O. Thomas and A. D. R. Phelps *In* AGARD Radar Propagation in the Arctic Jan. 1972 11 p refs (See N72-21121 12-07)
Avail: NTIS HC $6.00/MF $0.95

# 30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

**N72-21856** National Lending Library for Science and Technology, Boston Spa (England).
**METEORS VIEWED THROUGH THE TELESCOPES**
V. V. Fedynsky [1971] 3 p Transl. into ENGLISH from report of USSR Acad. of Sci.
(NLL-M-22218-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The Tunguska meteorite of 1908 is assumed to have been the result of a sudden release of energy contained within a celestial body and not due to a nuclear explosion. Radio wave studies of meteors in Somali and the study of meteoritic fallout are also considered. K.P.D.

**N72-21857*#** Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
**LUNAR TARGETING STUDY: LUNAR AND PLANETARY EPHEMERIS TAPES Interim Report**
W. G. Green and V. J. Matthys Jan. 1972 38 p ref
(Contract NAS8-26578)
(NASA-CR-123595; LMSC/HREC-D225368; HREC-6578-1) Avail: NTIS CSCL 22A

The Univac 1108 computer tape data formats are documented for the ephermeris tape generated by the Jet Propulsion Laboratory and the ephemeris tape used by the Quick Response Targeting Program (QRTP). Ephermeris tapes are used as the data source for the position and velocity components of those celestial bodies being considered in an integrated trajectory simulation program. The QRTP ephemeris tape has data only for lunar mission simulations. The JPL ephemeris tape has data for the moon and the nine planets. The ephemeris tapes, the data formats, the coordinate systems, and units are defined. The transformation from the mean-of-1950 coordinate system to the nearest mean Besselian year is given. Author

**N72-21858*#** Mobil Research and Development Corp., Dallas, Tex. Field Research Lab.
**LUMINESCENCE PETROGRAPHY OF LUNAR SAMPLES Final Report**
[1972] 21 p refs
(Contract NAS9-11610)
(NASA-CR-115494) Avail: NTIS CSCL 08G

Light-colored metaclastic rock fragments, mainly anorthositic breccias, are dominant in the lithic clasts of rock 14321 and constitute about 25% of the Apollo 14 soils. Concentration of anorthositic breccias is less in the Apollo 15 soils, but is higher in the Front samples. The Rille edge soils are rich in basalt fragments. The Apollo 15 soils are also rich in green glasses. True anorthosites in the Hadley region were found only at the St. George Crater site. Varying degrees of metamorphism were found in the anorthositic fragments, and luminescence zonations give independent evidence of metamorphism. Compositional zoning verifies the interpretation of luminescence. Rock 14321 gives evidence of modest annealing, but the light metaclastic fragments were metamorphosed before incorporation into the rock. Reaction rimming on plagioclase results in mosaicism and preferentially affects grains. The spectral analysis of luminescence in plagioclase shows that a red-infrared emission band is present in a small fraction of plagioclase grains. Samples from trench bottoms and from beneath a large boulder were compared with surface samples. Large variations in soil composition indicate marked layering in the Apollo 15 soils. Author

**N72-21859*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**RING STRUCTURE OF A NEUTRAL GAS CLOUD STUDIED IN A ONE-DIMENSIONAL EXPANSION INTO SPACE**
Robert E. Davidson Washington Apr. 1972 26 p refs
(NASA-TN-D-6760; L-8111) Avail: NTIS CSCL 03B

A one dimensional treatment of the expansion of a gas cloud of uncharged particles into vacuum is discussed. It is determined that the whole cloud does not change from continuum to free molecular flow at the same time. Some regions of the cloud make the transition sooner than others. An explanation of the ring structure observed during barium cloud experiments is presented using this conclusion. An analysis of the velocity distributions for the two kinds of flow yields a velocity distribution for the whole cloud that exhibits ring structure. Author

**N72-21860*#** McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
**LUMINESCENCE ANALYSIS OF LUNAR SAMPLES RETURNED BY APOLLO: LUMINESCENCE OF APOLLO 14 AND APOLLO 15 LUNAR SAMPLES Final Report, 1 May 1971 - 29 Feb. 1972**
Norman N. Greenman and H. Gerald Gross 29 Feb. 1972 32 p refs
(Contract NAS9-11679)
(NASA-CR-115512) Avail: NTIS CSCL 03B

Luminescence measurements were made of Apollo 14 lunar samples with far UV X-ray, and proton irradiation and of Apollo 15 lunar samples with X-ray irradiation. Preliminary efficiencies with the far UV are in the range 0.001 to 0.01; efficiencies with X-rays and protons are in the range 10 to the -8th to 10 to the -6th powers. The crystalline igneous rocks show higher efficiencies, in general, than the breccias and glasses, and the ratio of intensity of the green to the blue luminescence peak tends to be higher for the crystalline igneous rocks than for breccias and glasses. Therefore, both the efficiency and the spectral character appear to have a systematic relationship to lithologic type (granitic versus gabbroic versus fragmental) and to geologic history and processes on the moon (shocked versus unshocked or only mildly shocked material). Author

**N72-21861*#** Translation Consultants, Ltd., Arlington, Va.
**PRELIMINARY RESULTS OF LUNAR SOIL STUDY**
A. P. Vinogradov Washington NASA Apr. 1972 12 p Transl. into ENGLISH from Priroda (USSR), no. 12, Dec. 1970 p 5-9
(Contract NASw-2038)
(NASA-TT-F-13961) Avail: NTIS CSCL 03B

Preliminary data are presented on the lunar soil core sample brought back by Luna 16. The following groups of particles were separated from the larger fractions and are being studied: (1) basaltic rocks; (2) feldspathic rocks (anorthosite); (3) grains of individual minerals; (4) solidified spherules and beads; (5) breccias; (6) sinters; (7) glasses, and vitrified and scoriated particles; and (8) particles of metallic iron. K.P.D.

**N72-21862*#** Translation Consultants, Ltd., Arlington, Va.
**METEORITES ARE INTERPLANETARY SPACE PROBES**
A. K. Lavrukhina Washington NASA Apr. 1972 17 p refs Transl. into ENGLISH from Priroda (USSR), no. 12, Dec. 1970 p 10-16
(Contract NASw-2038)
(NASA-TT-F-13962) Avail: NTIS CSCL 03B

The results are given for investigations of 25 meteorites that have fallen in the past 15 years. The role of meteoroids as interplanetary space probes is explained and the manner in

which meteoroids have provided the boundary between the galactic and solar magnetic fields is discussed. Author

**N72-21863*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**ON THE STABILITY AND POINTING OF AN ATTACHED DOUBLE-GIMBAL EXPERIMENT PACKAGE**
Nelson J. Groom, John D. Shaughnessy, and Vilas D. Nene Washington Apr. 1972 45 p refs
(NASA-TN-D-6676; L-7898) Avail: NTIS CSCL 22B

The pointing capability of a double gimbal experiment isolation and control system of the Apollo telescope mount (ATM) type was investigated. Three composite structural models of an experiment package connected through frictionless gimbals to a carrier vehicle (including a rigid package-rigid carrier model, a rigid package-flexible carrier model, and a flexible package-flexible carrier model) were used, and a linear model of the nominal ATM gimbal control system is considered. A linear stability analysis was performed to verify stability of the control system with nominal gains. Transform techniques were used to compute pointing errors onboard the experiment package due to random crew motions input into the carrier vehicle. Results of the investigation indicate that there is no stability problem due to flexible coupling of the experiment package and the carrier, and that the ATM-type system is capable of pointing accuracies better than 0.1 arc second. Author

**N72-21864*#** Translation Consultants, Ltd., Arlington, Va.
**MEASUREMENT OF THE CONCENTRATION OF SOLID COMPONENT OF SUBSTANCES IN OUTER SPACE, PERFORMED ABOARD SPACECRAFT**
L. V. Leontyev Washington NASA Apr. 1972 22 p refs Transl. into ENGLISH of "Izmereniya Kontsentratsii Tverdoy Komponenty Veshchestva v Kosmicheskom Prostransive" Moscow, Acad. Sci. USSR, Inst. for Space Res. Rept. Pr-65
(Contract NASw-2038)
(NASA-TT-F-14188) Avail: NTIS CSCL 03B

Direct measurements made of concentrations of solid particles in outer space have yielded erratic results, hence an effort was made to reduce all the data collected up to this point. As a first approximation, basic model is presented of the distribution of solid particles in space. Author

**N72-21865*#** Translation Consultants, Ltd., Arlington, Va.
**LUNAR SOIL IN MARE IMBRIUM**
A. V. Ivanov, A. T. Bazilevskiy, and O. D. Rode Washington NASA Apr. 1972 5 p ref Transl. into ENGLISH from Prorpda (Moscow), no. 11, Nov. 1971 p 11-12
(Contract NASw-2038)
(NASA-TT-F-14181) Avail: NTIS CSCL 03B

The study of the soil sample brought back by Lunokhod 1 is discussed in brief with respect to regolith findings previously recorded. Author

**N72-21866*#** Translation Consultants, Ltd., Arlington, Va.
**THE LUNA 17 AUTOMATIC STATION ON MARE IMBRIUM**
A. A. Gurshteyn, K. B. Shingarava, A. A. Konopikhin, and V. P. Shashkina Washington NASA Apr. 1972 6 p ref Transl. into ENGLISH from Priroda (Moscow), no. 11, Nov. 1971 p 2-4
(Contract NASw-2038)
(NASA-TT-F-14176) Avail: NTIS CSCL 03B

The area of Mare Imbrium explored by Lunokhod 1 and the Luna 17 lunar probe is described in general terms. Author

**N72-21867*#** Translation Consultants, Ltd., Arlington, Va.
**MORPHOLOGY OF SMALL CRATERS IN THE LUNAR MARIA**
A. A. Pronin, Z. V. Popova, and V. D. Povich Washington NASA Apr. 1972 7 p ref Transl. into ENGLISH from Priroda (Moscow), no. 11, Nov. 1971 In ENGLISH and RUSSIAN
(Contract NASw-2038)
(NASA-TT-F-14177) Avail: NTIS CSCL 03B

A crater classification system is presented, and the conception of the impact explosion origin of small craters is discussed and confirmed. Author

**N72-21868*#** Translation Consultants, Ltd., Arlington, Va.
**STATISTICS ON SMALL CRATERS FROM LUNOKHOD 1 DATA**
A. A. Pronin and V. D. Popovich Washington NASA Apr. 1972 5 p Transl. into ENGLISH from Priroda (Moscow), no. 11, Nov. 1971 p 6-7
(Contract NASw-2038)
(NASA-TT-F-14178) Avail: NTIS CSCL 03B

The utility is demonstrated of using statistical analysis of crater distribution on lunar maria to determine their relative ages. Author

**N72-21869*#** Translation Consultants, Ltd., Arlington, Va.
**STATISTICAL ANALYSIS OF ROCK DISTRIBUTION FROM LUNOKHOD 1 DATA**
R. B. Zezin and P. A. Dubin Washington NASA Apr. 1972 6 p Transl. into ENGLISH from Priroda (Moscow), no. 11, 1971 p 9-11
(Contract NASw-2038)
(NASA-TT-F-14180) Avail: NTIS CSCL 03B

Statistical analyses of rock distribution on the lunar surface are discussed. It can be used to establish the direction taken by erosion processes and provide a basis for determining the relative age of different sections of the lunar surface. Author

**N72-21870*#** Northrop Services, Inc., Huntsville, Ala.
**PLANETARY RESONANCES, BI-STABLE OSCILLATION MODES, AND SOLAR ACTIVITY CYCLES**
H. P. Sleeper, Jr. Washington NASA Apr. 1972 61 p refs
(Contract NAS8-21810)
(NASA-CR-2035; TR-241-1053) Avail: NTIS CSCL 03B

The natural resonance structure of the planets in the solar system yields resonance periods of 11.08 and 180 years. The 11.08 year period is due to resonance of the sidereal periods of the three inner planets. The 180-year period is due to synodic resonances of the four major planets. These periods are also observed in the sunspot time series. The 11-year sunspot cycles from 1 to 19 are separated into categories of positive and negative cycles, Mode 1 and Mode 2 cycles, and typical and anomalous cycles. Each category has a characteristic shape, magnitude, or duration, so that statistical prediction techniques are improved when a cycle can be classified in a given category. These categories provide evidence for bistable modes of solar oscillation. The next minimum is expected in 1977 and the next maximum in 1981 or later. These epoch values are 2.5 years later than those based on typical cycle characteristics. Author

**N72-21871#** Institut d'Aeronomie Spatiale de Belgique, Brussels.
**BIBLIOGRAPHY, PART 8. 2: INTERPLANETARY SPACE [BIBLIOGRAPHIE, FASCICULE 8. 2: ESPACE INTERPLANETAIRE]**
1971 122 p refs
Avail: NTIS

A space bibliography is presented, including articles on the Moon; Venus, Mars, and other planets; comets and meteors; cosmic rays; gravitation; and the structure of space. K.P.D.

**N72-21872#** California Univ., Livermore. Lawrence Radiation Lab.
**SOFT X-RAY SURVEY FROM THE GALACTIC CENTER TO VELA**
G. Burginyon, R. W. Hill, R. J. Grader, T. M. Palmieri, F. D. Seward, and J. P. Stoering 12 Jul. 1971 18 p refs
(Contract W-7405-eng-48)
(UCRL-51090) Avail: NTIS

A 640 sq cm proportional counter system, sensitive from

0.2 to 12 keV, was used to survey the galactic plane from Sagittarius to Vela. Spatial resolution was 1 deg at best. The soft X-ray sky (< keV) is dominated by a region of strong emission in the vicinity of Vela X and has a different appearance from the sky viewed at photon energies a few keV higher. Many sources were located in one dimension (i.e., seen on one scan only) in the direction of the galactic center. Two strong sources-Gx 292-0 or Cen 3, and Gx 322+0 or Cir 1-were seen on two scans and were located to within 0.2 sq deg. Another weaker source-Gx 296-2 or Cen 5-was seen on two scans and was located to within 0.6 sq deg. A definite source of soft X-rays was seen which seems to coincide with the object eta Carinae. The source Nor 1 was found to emit a greater flux of soft X-rays than other surrounding objects relative to its overall strength. Spectra were derived for all sources and numbers are given for interstellar material in the line of sight. Author (NSA)

**N72-21873#** European Space Operations Center, Darmstadt (West Germany).
**A RELIABLE DERIVATION OF THE PERTURBATIONS DUE TO ANY ZONAL AND TESSERAL HARMONICS OF THE GEOPOTENTIAL FOR NEARLY-CIRCULAR SATELLITE ORBITS**
M. C. Eckstein and F. Hechler Paris ESRO Jun. 1970 41 p refs
(ESRO-SR-13) Avail: NTIS

The geopotential is expressed in terms of orbital elements whose Lagrange equations remain regular for vanishing eccentricity. The latter is assumed to be of order J sub 20, and the expansions are carried up to order J squared sub 20. The algebraic manipulations were performed on the computer with the aid of FORMAC programs which are given. The results represent a revised edition of Ustinov's theory for nearly circular orbits and serve as a reliable basis for orbit determination and orbit prediction purposes. Author (ESRO)

**N72-21874#** European Space Operations Center, Darmstadt (West Germany).
**A METHOD AND A COMPUTER PROGRAM FOR THE QUICK DETERMINATION OF A PRELIMINARY LAUNCH WINDOW FOR SATELLITES WITH MODERATELY-TO-HIGHLY ECCENTRIC ORBITS**
E. A. Roth Paris ESRO Nov. 1970 23 p refs
(ESRO-SR-15) Avail: NTIS

The principles are described for a method for the rapid calculation of launch windows for satellites with orbits of moderate-to-high eccentricity. The most important perturbations are considered, namely the oblateness of the earth, the air drag and the lunar-solar effects. The perturbations are averaged analytically over one revolution of the satellite and at perigee the increments are added to the orbital elements. The method is very rapid and fairly accurate. Author (ESRO)

**N72-21875#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**CONCERNING THE POSSIBLE NATURE OF CLOUDS IN THE ATMOSPHERE OF VENUS**
K. Ya. Kondaten and O. I. Smoktii 28 Oct. 1971 30 p refs Transl. into ENGLISH from Probl. Fiz. Atmosfery (Leningrad), no. 8, 1970 p 11-31
(AF Proj. 7360)
(AD-734919; FTD-MT-24-1399-71) Avail: NTIS CSCL 03/2

Results are presented of physical properties of the atmosphere of Venus detected by visual, photometric, polarization, spectrometric, and radio detection methods. The infrared spectra of the cumulus clouds are given at various zenith angles of the albedo. A layered structure of clouds is suggested based on spectroscopic data. The infrared spectra of the ice crystal clouds at low temperatures are comparable to those of the clouds on Venus. Author (GRA)

**N72-21876#** Aerospace Corp., El Segundo, Calif. Lab. Operations.
**MARS, JUPITER, SATURN AND URANUS: 3.3 mm BRIGHTNESS TEMPERATURES AND A SEARCH FOR VARIATIONS WITH TIME OR PHASE ANGLE**
Eugene E. Epstein, Michael M. Dworetsky, John W. Montgomery, William G. Fogarty, and Ronald A. Schorn 1 Aug. 1971 22 p refs Prepared in cooperation with JPL
(Contract F04701-71-C-0172)
(AD-728204; TR-0172(2230-20)-7; SAMSO-TR-71-152) Avail: NTIS CSCL 03/2

Extensive 3.3 mm observations yield disk average brightness temperatures for Mars, Jupiter, Saturn, and Uranus. The values for the first three planets are corrected to heliocentric distances of 1.524, 5.203, and 9.540 AU, respectively. Any variation of the temperature of Mars with phase angle is less than a few percent; this upper limit is consistent with an expected variation of about or less than 3 percent. The measurements from mid-1965 to Nov. 1969 contain no confirmed variations in the brightness temperatures of Jupiter and Saturn larger than approximately 4 and approximately 7 percent, respectively.
Author (GRA)

**N72-21877#** Bureau of Mines, Washington, D.C.
**GRAVITY FLOW OF POWDER IN A LUNAR ENVIRONMENT. PART 2: ANALYSIS OF FLOW INITIATION**
William G. Pariseau 1971 25 p refs
(PB-205504; BM-RI-7577-Pt-2) Avail: NTIS CSCL 08M

A small displacement/small strain finite element technique is described which utilizes the constant strain triangle and incremental constitutive equations for elastic-plastic media that are nonhardening and which obey a Coulomb yield condition. The method was applied to the analysis of gravity flow initiation in a V-shaped hopper containing a powder under lunar environment conditions. Three methods of loading were examined.
Author (GRA)

# 31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

**N72-21878*#** Unidev, Inc., Huntsville, Ala.
**EVALUATION OF SKYLAB IB SENSITIVITY TO ON-PAD WINDS WITH TURBULENCE**
T. Coffin Jan. 1972 99 p refs
(Contract NAS8-26702)
(NASA-CR-123564; UR-72-00014) Avail: NTIS CSCL 22C

Computer simulation was performed to estimate displacements and bending moments experienced by the SKYLAB 1B vehicle on the launch pad due to atmospheric winds. The vehicle was assumed to be a beam-like structure represented by a finite number of generalized coordinates. Wind flow across the vehicle was treated as a nonhomogeneous, stationary random process. Response computations were performed by the assumption of simple strip theory and application of generalized harmonic analysis. Displacement and bending moment statistics were obtained for six vehicle propellant loading conditions and four representative reference wind profile and turbulence levels. Means, variances and probability distributions are presented graphically for each case. A separate analysis was performed to indicate the influence of wind gradient variations on vehicle response statistics. Author

**N72-21879*#** McDonnell-Douglas Astronautics Co., Huntington Beach, Calif. Biotechnology and Power Dept.
**SPACE STATION VENTILATION STUDY Final Report**

G. V. Colombo and G. E. Allen Feb. 1972 134 p refs -
(Contract NAS8-26267)
(NASA-CR-123593; MDC-G2835) Avail: NTIS CSCL 22B

A ventilation system design and selection method which is applicable to any manned vehicle were developed. The method was used to generate design options for the NASA 33-foot diameter space station, all of which meet the ventilation system design requirements. System characteristics such as weight, volume, and power were normalized to dollar costs for each option. Total system costs for the various options ranged from a worst case $8 million to a group of four which were all approximately $2 million. A system design was then chosen from the $2 million group and is presented in detail. A ventilation system layout was designed for the MSFC space station mockup which provided comfortable, efficient ventilation of the mockup. A conditioned air distribution system design for the 14-foot diameter modular space station, using the same techniques, is also presented. The tradeoff study resulted in the selection of a system which costs $1.9 million, as compared to the alternate configuration which would have cost $2.6 million.
Author

**N72-21880*#** McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
**MODULAR SPACE STATION DETAILED PRELIMINARY DESIGN. VOLUME 1: SECTIONS 1 THROUGH 4.4**
Nov. 1971 436 p
(Contract NAS8-25140)
(NASA-CR-123544; MDC-G2582-Vol-1-Sect-1-4.4) Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

Detailed configuration and subsystems preliminary design data are presented for the modular space station concept. Each module comprising the initial space station is described in terms of its external and internal configuration, its functional responsibilities to the initial cluster, and its orbital build up sequence. Descriptions of the subsequent build up to the growth space station are also presented. Analytical and design techniques, tradeoff considerations, and depth of design detail are discussed for each subsystem. The subsystems include the following: structural/mechnaical; crew habitability and protection; experiment support; electrical power; environmental control/life support; guidance, navigation, and control; propulsion; communications; data management; and onboard checkout subsystems. The interfaces between the station and other major elements of the program are summarized. The rational for a zero-gravity station, in lieu of one with artificial-gravity capability, is also summarized.
Author

**N72-21881*#** McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
**MODULAR SPACE STATION DETAILED PRELIMINARY DESIGN. VOLUME 2: SECTIONS 4.5 THROUGH 4.8**
Nov. 1971 578 p
(Contract NAS8-25140)
(NASA-CR-123545; MDC-G2582-Vol-2-Sect-4.5-4.8) Avail: NTIS HC $6.00/MF $0.95 CSCL 22B
For abstract, see N72-21880.

**N72-21882*#** McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
**MODULAR SPACE STATION DETAILED PRELIMINARY DESIGN. VOLUME 3: SECTIONS 4.9 THROUGH 6**
Nov. 1971 370 p
(Contract NAS8-25140)
(NASA-CR-123543; MDC-G2582-Vol-3) Avail: NTIS HC $6.00/MF $0.95 CSCL 22B
For abstract, see N72-21880.

**N72-21883*#** McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
**CREW OPERATIONS**
Nov. 1971 240 p
(Contract NAS8-25140)
(NASA-CR-121087; MDC-G2595) Avail: NTIS CSCL 22A

The requirements for the activities involved, and the procedures used by the crew in the operations of the modular space station are presented. All crew-related characteristics of the station and its operations are indicated. The interior configuration and arrangement of each of the space station modules, the facilities and equipment in the module and their operation are described as related to crew habitability. The crew activities and procedures involved in the operation of the station in the accomplishment of its primary mission are defined. The operations involved in initial station buildup, and the on-orbit operation and maintenance of the station and its subsystems to support the experimental program are included. A general description of experiment operations is also given.
Author

**N72-21884*#** McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
**SUPPORTING RESEARCH AND TECHNOLOGY**
Nov. 1971 182 p ref
(Contract NAS8-25140)
(NASA-CR-123541; MDC-G2596; MSFC-DPD-235/DR-SE-10) Avail: NTIS CSCL 22B

The development of definition of the modular space station is discussed. The modular approach was evaluated, the requirements were defined, and program definition and design were accomplished. The features of the program which significantly affect the initial development and early operating costs were identified and their impacts on the program were assessed. Specifications of various systems and components are included.
Author

**N72-21885*#** Smithsonian Astrophysical Observatory, Cambridge, Mass.
**APOLLO CONTAMINATION ANALYSIS Final Report**
Dec. 1971 98 p refs
(Grant NGR-09-015-105)
(NASA-CR-125934) Avail: NTIS CSCL 06M

The Apollo 12 photographic observations of clouds produced by venting liquids into space were reduced and analyzed. The number of Baker-Nunn photographs required that film measurement and data processing be automated, and the microdensitometer was adapted to automatic digital operation. Computer programs were prepared to process the image-density measurements. A substantial selection of Apollo 12 data was processed; both hydrogen and oxygen clouds are represented. Some limited data were obtained from Apollo 13 and 14 missions. During the Apollo 12 data analysis, the theory and models of cloud phenomena were refined because the models were initially applied to inferior oxygen data from earlier missions. The reported observations of water dumps from Apollo 12 are also discussed, along with the use of the oxygen and hydrogen data from Apollo 12 photographs with the cloud models.
Author

**N72-21886*#** Chrysler Corp., New Orleans, La. Space Div.
**SPACE SHUTTLE: LONGITUDINAL AND LATERAL AERODYNAMIC CHARACTERISTICS OF THE 0.0035-SCALE GD/C AEROSPACE BOOSTER (B-15B-1)**
J. M. DeBevoise and R. F. McGinnis Feb. 1972 1265 p
(Contract NAS8-4016)
(NASA-CR-119992; DMS-DR-1102) Avail: NTIS HC (individually priced)/MF $0.95 CSCL 22B

Force tests on a 0.0035-scale model of the General Dynamics/Convair space shuttle B-15B-1 booster were conducted in the MSFC trisonic wind tunnel during February and March 1971. Longitudinal and lateral characteristics were obtained at Mach numbers from 0.6 to 4.96. The configuration tested had a low delta wing, all-movable canard controls of delta planform, and a single vertical tail. Most of the test was devoted to obtaining data relevant to the transition from atmospheric reentry to subsonic cruise. In that portion of the test the angles of attack ranged from 6 degrees to 60 degrees, and yaw runs

were made at angles of attack of 15 and 35 degrees. The rest of the test was devoted to obtaining booster-alone buildup data relevant to the launch phase. For the launch phase, the Mach number range was from 0.6 to 2.0, the angles of attack were from -10 to +10 degrees, and yaw runs were made at zero angle of attack. Author

**N72-21887*#** National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**APOLLO EXPERIENCE REPORT: LUNAR MODULE REACTION CONTROL SYSTEM**
Chester A. Vaughan, Robert Villemarette, Witalij Karakulko, and Donald R. Blevins Washington Mar. 1972 23 p
(NASA-TN-D-6740; MSC-S-315) Avail: NTIS CSCL 22B

The design, development and qualification of the reaction control system for the Apollo lunar module are described. The lunar module reaction control system used many of the components developed and qualified for the service module reaction control system. The system was qualified for manned flight during the unmanned Apollo 5 mission on January 22 and 23, 1968, and has operated satisfactorily during all manned lunar module flights including Apollo 11, the first manned landing on the moon. Author

**N72-21888*#** Chrysler Corp., New Orleans, La.
**LOW SPEED AERODYNAMIC CHARACTERISTICS OF THE GD/C B-18E3 BOOSTER SADSAC/space shuttle wind tunnel test data report**
W. V. Carter and W. H. Gallaher Mar. 1972 72 p
(Contract NAS8-4016)
(NASA-CR-120035; NASA-SER-S-0252; DMS-DR-1223) Avail: NTIS CSCL 22B

A 0.02 scale model of the B-18E3 space shuttle booster was tested in a low speed wind tunnel to evaluate the low speed aerodynamic charactersitics. The basic configuration, including build-up, was tested at a Mach number of 0.201 and Reynolds number per foot of 1.39 million. The normal angle-of-attack range was -4 to +24 degrees in 2 degree increments, at sideslip angles of 0 and 5 degrees. Some lateral data were obtained at the sideslip angle range of -6 to 10 degrees at angles-of attack of 0, 10, and 15 degrees. Data were obtained for canard, split elevon, and split rudder deflections. Author

**N72-21889*#** Chrysler Corp., New Orleans, La.
**AERODYNAMIC STATIC STABILITY CHARACTERISTICS, FIN EFFECTIVENESS, AND FIN LOCATION OF THE MSFC 33-FOOT PRESSURE FED BOOSTER AT HIGH ANGLES OF ATTACK SADSAC/space shuttle wind tunnel test data report**
Thomas Hamilton Mar. 1972 335 p
(Contract NAS8-4016)
(NASA-CR-120040; NASA-SER-S-1049; DMS-DR-1240) Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

Experimental aerodynamic investigations were conducted in the NASA/MSFC 14 x 14 inch trisonic wind tunnel during early February 1972 on a 0.00280 scale model of the MSFC 33-foot diameter space shuttle pressure fed booster configuration. The basic configuration tested was a 40 deg cone/cylinder/7 deg frustrum designated the MSFC 33 foot pressure fed booster. Six component aerodynamic force and moment data were recorded over a Mach number range from 0.9 to 5.0 at angles of attack from +20 to +90 at 0 deg sideslip and over a sideslip range from -10 to +10 deg at 30, 50, 60 and 80 deg angles of attack. Primary configuration variables were fin deflection angle and vertical position on the frustrum. Author

**N72-21890*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**ANALYSIS OF REQUIREMENTS FOR GEOS-C LASER CUBE-CORNER REFLECTOR PANELS**
Peter O. Minott Jan. 1972 45 p
(NASA-TM-X-65862; X-524-72-33) Avail: NTIS CSCL 22B

A mathematical analysis of the tradeoffs and requirements was performed to develop an improved array design which will give stronger returns at lower elevation angles and reduce pulse spread in the return. It was determined that a zenith angle of 75 deg can be obtained with an array with an area of 0.28 sq m, if the array is shaped on the surface of a 45 deg cone whose axis is coincident to the satellite axis. The total weight of the truncated pyramid array with 270 cube corners is calculated to be not more than 50% greater than the GEOS 2 array, while the efficiency is increased 275%. N.E.N.

**N72-21891*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**DEVELOPMENT AND TESTING OF THE FLIGHT COMMAND SUBSYSTEM FOR THE MARINER MARS 1971 SPACECRAFT**
W. H. Chitty 15 Mar. 1972 12 p ref
(Contract NAS7-100)
(NASA-CR-126038; JPL-TM-33-531) Avail: NTIS CSCL 22B

The flight command subsystem for the Mariner Mars 1971 spacecraft is of the same basic design and construction as that for Mariner Mars 1969 except for its expanded capability. Its primary purpose is to provide remote control for the spacecraft. This report briefly describes the design changes, fabrication, and significant problems associated with the development of the Mariner Mars 1971 flight command subsystem. Author

**N72-21892*#** Grumman Aerospace Corp., Bethpage, N.Y.
**STUDY OF STABILITY AND CONTROL MOMENT GYRO WOBBLE DAMPING OF FLEXIBLE, SPINNING SPACE STATIONS Final Report, 28 Jun. 1971 - Feb. 1972**
Howard Berman, Joel Markowitz, and Will Holmer Feb. 1972 343 p refs
(Contract NAS9-11991)
(NASA-CR-115525) Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

An executive summary and an analysis of the results are discussed. A user's guide for the digital computer program that simulates the flexible, spinning space station is presented. Control analysis activities and derivation of dynamic equations of motion and the modal analysis are also cited. J.A.M.

**N72-21893*#** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
**ZERO GRAVITY SHADOW SHIELD ALIGNER Patent Application**
Frank S. Howard, inventor (to NASA) Filed 4 Jun. 1971 11 p
(NASA-Case-KSC-10622-1; US-Patent-Appl-SN-149983) Avail: NTIS CSCL 22B

An apparatus is described for aligning objects in outer space, such as shadow shields and cryogenic storage tanks, with the sun. The apparatus includes equally spaced vanes having a reflective outer surfaces so that when the pressures exerted by the light waves from the sun are equal on all of the vanes the shadow shield is aligned with the sun. NASA

**N72-21894*#** National Aeronautics and Space Administration, Washington, D.C.
**SPACECRAFT PLATFORM COST ESTIMATING RELATIONSHIPS**
Werner M. Gruhl Mar. 1972 36 p
(NASA-TM-X-68851) Avail: NTIS CSCL 22B

The three main cost areas of unmanned satellite development are discussed. The areas are identified as: (1) the spacecraft platform (SCP), (2) the payload or experiments, and (3) the postlaunch ground equipment and operations. The SCP normally accounts for over half of the total project cost and accurate estimates of SCP costs are required early in project planning as a basis for determining total project budget requirements. The development of single formula SCP cost estimating relationships (CER) from readily available data by statistical linear regression

analysis is described. The advantages of single formula CER are presented. Author

**N72-21895*#** Radio Corp. of America, Princeton, N.J. Astro Electronics Div.
**ITOS/SPACE SHUTTLE STUDY**
30 Mar. 1971 68 p
(Contract NAS5-21600)
(NASA-CR-122398; AED-R-3689) Avail: NTIS CSCL 22A

The results are reported of a study to explore the potential cost reductions in the operational ITOS weather satellite program as a consequence of shuttle/bug availability for satellite placement and retrieval, and satellite servicing and maintenance. The study program was divided into shuttle impact on equipment and testing costs, and shuttle impact on overall future ITOS operational program costs, and shuttle impact on configuration. It is concluded that savings in recurring spacecraft costs can be realized in the 1978 ITOS program, if a space shuttle is utilized. F.O.S.

**N72-21896#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Werkstoffe unter Weltraumbedingungen.
**CONTAMINATION PROBLEMS IN SPACE VEHICLES [KONTAMINATIONSPROBLEME BEI RAUMFAHRZEUGEN]**
Walter Wilkens 1971 39 p refs In GERMAN; ENGLISH summary Presented at the 4th DGLR Annual Meeting, Baden-Baden, West Ger., 11-13 Oct. 1971
Avail: NTIS

Potential contamination sources which could result in severe degradation effects on the functional properties of spacecraft are reviewed, and transport and sorption phenomena are discussed. The work is based partly on measurements of outgassing of plastics, coatings and bearings in vacuum, and the sorption of vapors on special surfaces. ESRO

**N72-21897#** Entwicklungsring Nord, Bremen (West Germany). Abteilung fuer Astrodynamik.
**POSSIBILITIES FOR PRODUCTION IN SPACE [MOEGLICHKEITEN DER FERTIGUNG IM WELTRAUM]**
A. Tegtmeier and B. Franke 1971 89 p In GERMAN Presented at the 4th DGLR Annual Meeting, Baden-Baden, West Ger., 11-13 Oct. 1971
Avail: NTIS

A survey is given to the manufacturing potential in orbital workshops. The possibilities of obtaining improved products due to the low gravity, vacuum, and thermal conditions are outlined, and examples of methods and processes of potential application are given in the fields of chemistry, pharmaceutics, optical components, crystal growth, metallurgy, and composite materials. The possible configuration of the spacecraft is described. ESRO

**N72-21898#** Entwicklungsring Nord, Bremen (West Germany).
**INTERNATIONAL COLLABORATION BETWEEN ERNO AND MCDONNEL DOUGLAS IN PHASE-B OF THE SPACE SHUTTLE PROJECT AND PRELIMINARY RESULTS [INTERNATIONALE ZUSAMMENARBEIT ERNO-MCDONNELL DOUGLAS IN DER PHASE B DES SPACE SHUTTLE-PROJEKTES UND VORLAEUFIGE ERGEBNISSE]**
J. Haseloff, J. K. Bock, and M. Fuchs 1971 34 p In GERMAN Presented at the 4th DGLR Annual Meeting, Baden-Baden, West Ger., 11-13 Oct. 1971
Avail: NTIS

Cooperation in the design and development of a space shuttle is reported. Low speed wind tunnel tests of a delta-wing model and configuration modifications to improve directional stability are emphasized. Futher German participation is proposed for development of structural components. Development and manufacturing costs are given. ESRO

**N72-21899#** Analytic Sciences Corp., Reading, Mass.
**ADAPTIVE CONTROL WITH EXPLICIT PARAMETER IDENTIFICATION FOR TACTICAL MISSILES**
Charles F. Price and William D. Koenigsberg 1 Dec. 1971 125 p refs
(Contract N00014-69-C-0391)
(AD-735488; TASC-TR-170-3) Avail: NTIS CSCL 16/4

The report discusses the design of an adaptive autopilot for a tactical missile. The subject autopilot explicitly identifies unknown, time-varying parameters and makes corresponding adjustments to autopilot feedback gains on the basis of a pole-assignment technique. The method of identification used is the extended Kalman filter. Effects of sensor measurement noise level, modeling uncertainties, autopilot input signal characteristics, and length of the measurement sampling interval are discussed. Identification accuracy is verified by computer simulation. Author (GRA)

# 32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

**N72-21900#** Advisory Group for Aerospace Research and Development, Paris (France).
**SPECIALISTS MEETING ON STRESS CORROSION TESTING METHODS**
Jan. 1972 332 p refs Presented at Struct. and Mater. Panel 33d Meeting, Brussels, 5-6 Oct. 1971
(AGARD-CP-98) Avail: NTIS HC $6.00/MF $0.95

The basic objectives of the Specialists Meeting were to discuss: (1) the utility and significance of stress corrosion cracking data to current engineering and design practices; (2) the progress being made NATO countries toward standardization of test techniques for stress corrosion cracking; and (3) those test methods which might be recommended as standard techniques in the immediate future. Also included are the types and quality of data which are useful in design analysis, the attitudes and activities of various corrosion and fracture committees in the U.S. and Europe toward standardization techniques, and summaries of stress corrosion cracking and test equipment used to measure corrosion in various materials, aircraft structures, and space shuttle designs. For individual titles, see N72-21901 through N72-21931.

**N72-21901#** Battelle-Northwest, Richland, Wash. Pacific Northwest Labs.
**ENGINEERING UTILITY AND SIGNIFICANCE OF STRESS CORROSION CRACKING DATA**
W. E. Anderson *In* AGARD Specialist's Meeting on Stress Corrosion Testing Methods Jan. 1972 23 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

Some historical experiences with cracking and fracture problems are explored to indicate the significance of corrosion acting concomitantly with stress. These experiences suggest that cracks develop either in 'open' or 'closed' areas; and, either at regions accessible to the ambient environment and direct view, or, at regions which are structurally hidden. Special attention was given to aircraft structures and various other materials. Data cover specimen configurations, methods suitable for low cost testing of specimens, and estimates of service life under loading and environmental conditions. A definition of stress corrosion is included. Author

**N72-21902#** Reynolds Metals Co., Richmond, Va. Metallurgical Research Div.
**PROGRESS TOWARD STANDARIZATION OF SCC TEST**

**TECHNIQUES BY THE AMERICAN SOCIETY FOR TESTING AND MATERIALS** c14

H. Lee Craig, Jr. *In* AGARD Specialist's Meeting on Stress Corrosion Testing Methods Jan. 1972 10 p (See N72-21900 12-32)

Avail: NTIS HC $6.00/MF $0.95

The work of a subcommittee on test standards for stress corrosion of metals and other materials is presented. The committee covers (1) smooth speciments and test jig, (2) test environments and specific material tests, (3) corrosion fatigue, and (4) precracked specimens. Author

**N72-21903#** Aluminum Co. of America, Pittsburgh, Pa. Chemical Metallurgy Div.

**PROGRESS TOWARD STANDARDIZATION OF SCC TEST TECHNIQUES BY THE NATIONAL ASSOCIATION OF CORROSION ENGINEERS AND THE ALUMINUM ASSOCIATION** c14

Donald O. Sprowls *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 20 p (See N72-21900 12-32)

Avail: NTIS HC $6.00/MF $0.95

The stress corrosion testing of high strength, heat treatable aluminum alloys is discussed. Three tempers of alloy 7075 was laboratory tested for the purposes of: (1) comparing three types of smooth test specimens, (2) ascertaining the uniformity of test results that can be expected with a closely controlled procedure for the 3.5% NaCl alternate immersion test, (3) evaluating other corrodents that do not cause severe pitting of these alloys, and (4) relating the SCC (stress corrosion cracking) performance in these laboratory tests with that in outdoor atmospheres. Author

**N72-21904#** Newcastle-upon-Tyne Univ. (England). Dept. of Metallurgy.

**STRESS CORROSION TEST METHODS: THE EUROPEAN FEDERATION OF CORROSION CONTRIBUTION** c14

R. N. Parkins *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 7 p (See N72-21900 12-32)

Avail: NTIS HC $6.00/MF $0.95

A precis is given of the major points on stress corrosion test methods as compiled by the European Federation of Corrosion Working Party. The data points to some of the problems associated with the various methods of testing, such as the extensive use of time to failure as a parameter that measures susceptibility and the apparently poor reproducibility of threshold stress intensity values for stress corrosion cracking. On the environmental side of testing, the dangers in the use of standard solutions are indicated and the necessity, in simulating service failures, of precisely reproducing the composition of the environment and the relevant electrode potential are shown. Author

**N72-21905*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**SOME IMPORTANT CONSIDERATIONS IN THE DEVELOPMENT OF STRESS CORROSION CRACKING TEST METHODS** c14

R. P. Wei (Lehigh Univ.), S. R. Novak (US Steel Corp., Monroeville, Pa.), and D. P. Williams *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 10 p refs (See N72-21900 12-32)

(Contract N00014-68-A-0514)

(NASA-TM-X-68303) Avail: NTIS CSCL 14B

The need for recognizing certain potentially serious problems in the development of standard test methods for stress corrosion cracking studies is discussed. The importance of recognizing and satisfying the basic assumptions of the linear-elastic fracture mechanics analysis in experimentation is re-emphasized. The effects of nonsteady-state crack growth, including incubation, must be taken into account in determining the crack growth kinetics. These effects and the influences of steady-state crack growth kinetics, as well as, a host of geometrical, material and environmental variables, must be considered in arriving at suitable criteria for KISCC (apparent threshold for stress corrosion cracking) determinations. Author

**N72-21906#** British Steel Corp., Sheffield (England).

**CURRENT PROGRESS IN THE COLLABORATIVE TESTING PROGRAMME OF THE STRESS CORROSION CRACKING (FRACTURE MECHANICS) WORKING GROUP**

A. H. Prest and P. McIntyre *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 17 p refs (See N72-21900 12-32)

Avail: NTIS HC $6.00/MF $0.95

A preliminary analysis is presented of the initial results of the Collaborative Testing Program of the Stress Corrosion Cracking (Fracture Mechanics) Working Group of the BSC Corporate Laboratories. In this analysis the results are interpreted in terms of the influences of specimen geometry, maximum fatigue precracking stress intensity, test temperature and laboratory error. It is concluded that the only significant errors can be attributed to differences in the calibration and accuracy of testing equipment between the participating laboratories and to failure to adhere to the recommended testing procedure which is found to be satisfactory for the material and environment which were used. Author

**N72-21907#** Leeds Univ. (England). Dept. of Metallurgy.

**THE SCIENCE COMMITTEE CONFERENCE ON THE THEORY OF STRESS CORROSION CRACKING OF ALLOYS** c17

J. C. Scully *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 6 p refs (See N72-21900 12-32)

Avail: NTIS HC $6.00/MF $0.95

The general aspects of stress corrosion cracking as well as individual alloy systems are considered. Of particular interest to testing methods were (1) repassivation, and (2) measurements of crack velocity. These are discussed and their relevance to testing methods is emphasized. Comparison between different alloys or of different heat treatments of an alloy can only be made if the relationship between mechanical, metallurgical and electrochemical variables on crack propagation kinetics is fully determined. Author

**N72-21908#** Tyco Labs., Inc., Waltham, Mass. Materials Science Dept.

**MEASURING THE DEGREE OF CONJOINT ACTION BETWEEN STRESS AND CORROSION IN STRESS CORROSION**

Franklin H. Cocks *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 7 p (See N72-21900 12-32)

Avail: NTIS HC $6.00/MF $0.95

A stress corrosion testing method which allows a quantitative separation between the effects of stress and those of corrosion in causing stress corrosion damage is described. This test involves the measurement of the reduction in subsequent stress corrosion life which is brought about by initially exposing the sample to the corrosive environment without any stress being applied (precorrosion). If a given alloy is susceptible only to the combination of stress and corrosion (true stress corrosion), then such a preexposure would not be expected to greatly reduce its subsequent stress corrosion lifetime. If, however, a corrosion process that is not accelerated by stress is required to initiate the failure process, then such preexposure without applied stress may be found to be almost as damaging as an equal amount of exposure carried out under stress. A stress corrosion index (SCI) is defined which quantitatively measures these effects. Data obtained by this method are presented for a high strength aluminum alloy (7075) tested in buffered Nacl solution. For specimens of this alloy having a machined surface finish, 80% of the time required to produce failure in normal stress corrosion tests is found to be due to a process which is not accelerated by applied stress. An explanation for this behavior is offered in

terms of the existence of a higly deformed surface layer within which any well defined grain boundaries have been destroyed. This surface layer must be penetrated by pitting before a true stress corrosion process can begin. Author

N72-21909# Bell Aerospace Co., Buffalo, N.Y.
**THE pH AND POTENTIAL MEASUREMENTS DURING STRESS CORROSION OF ALUMINUM ALLOYS** c17
J. A. Davis *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 15 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

A technique was described for using small tip diameter microelectrodes to study the stress corrosion behavior of various aluminum alloys exposed to chloride environments. Several general observations concerning the stress corrosion behavior of aluminum alloys were made: (1) propagation of a stress corrosion crack is always accompanied by a decrease in pH near the crack tip; (2) increasing the stress intensity to above KISCC (threshold stress intensity for stress corrosion cracking) results in a rapid active shift in corrosion potential; and (3) as cracks progress, the corrosion potential slowly drifts in the active direction. A general mechanism for stress corrosion based on these observations is that crack propagation occurs by active-path dissolution with a minimum applied stress required to rupture the passive film and initiate crack propagation. Author

N72-21910# Welding Inst., Cambridge (England).
**STRESS CORROSION TESTING OF WELDED JOINTS** c14
T. G. Gooch *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 7 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

The techniques used for assessing the stress corrosion behavior of welded joints are outlined. Special attention was given to quantitative assessment of the suceptibility of weldments in the range of transformable steels, the cause of failure, and the effects of material composition and microstructure. Several illustrations of the results are given. Author

N72-21911# Department of Energy, Mines and Resources, Ottawa (Ontario). Corrosion Section.
**SCREENING TESTS OF SUSCEPTIBILITY TO STRESS CORROSION CRACKING** c14
G. J. Biefer and J. G. Garrison *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 9 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

For five high strength alloys, susceptibilities to the propagation of stress-corrosion cracking (SCC) were assessed. Using 3.5% NaCl solution as the medium, both parent and weld metals were investigated. Specimens were studied under freely corroding conditions, and also cathodically protected at the potentials given by cadmium and by zinc sacrificial anodes. The cantilever test was used; the test specimens, cut from 1/2- and 3/4-in. plates, were bars notched on both the sides and the top. Prior to tests a pre-crack was always produced at the base of the top notch by fatiguing in air. The equipment was designed so that specimens, loaded as cantilevers, were broken by means of a steadily rising load. This was applied by dripping water at a constant rate into a container suspended from the end of the cantilever beam. Results were reported in terms of the nominal stress intensities K* at fracture. While, strictly speaking, only of qualitative significance, reproducibility of the K* values was good and the effects of metallurgical and environmental factors could be readily estimated. Author

N72-21912# Naval Air Development Center, Johnsville, Pa.
**STRESS CORROSION TESTING OF TITANIUM ALLOYS**
S. J. Ketcham, C. E. Neu, and S. Goldberg (Naval Air Sys. Command) *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 8 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

Results are presented of two studies: (1) effect of grain flow orientation on stress corrosion susceptibility of two titanium alloys and (2) stress corrosion tests of titanium electron beam weldments. Emphasis is on test specimens used and on some properties of titanium alloys which have to be considered when conducting stress corrosion tests. Author

N72-21913# British Steel Corp., Sheffield (England).
**FACTORS INFLUENCING THRESHOLD STRESS INTENSITY VALUES AND CRACK PROPAGATION RATES DURING STRESS CORROSION CRACKING TESTS OF HIGH STRENGTH STEELS**
A. H. Priest and P. McIntyre *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 12 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

Threshold stress intensity values for stress corrosion cracking (KISCC) of a number of steels was shown to be related to the formation of a continuous stretch zone at the fatigue crack tip. Both KISCC and crack propagation rate (KIC) values are influenced by the yield strength and inclusion density of the steel. The relative values of KISCC determined by arrest and initiation methods and stress corrosion crack growth rates are influenced by the effectiveness of stress corrosion cracks as stress concentrators since intergranular cracks become progressively more blunt as they propagate while the reverse can be true of transgranular cracks. Observed stress corrosion crack propagation rates are also influenced by the failure to attain equilibrium in specimens of conventional length and by the presence of crack curvature and crack branching where these occur. Author

N72-21914# Westinghouse Research Labs., Pittsburgh, Pa. Mechanics Dept.
**AN APPARATUS FOR STRESS CORROSION TESTING WITH LARGE PRECRACKED WOL SPECIMENS**
L. J. Ceschini and W. G. Clark, Jr. IN AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 9 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

A laboratory test unit designed for KISCC (value of plane-strain stress-intensity factor below which an existing crack will not grow due to stress corrosion) and stress corrosion crack growth rate testing with large precracked WOL (wedge-opening-loading) specimens is described. The apparatus involves the use of a unique hydraulic loading arrangement which provides a convenient means of generating the relatively high loads required for stress corrosion testing with large WOL specimens. Additional features of the test unit include the ability to continuously monitor crack growth during the test and also the ability to test in an enclosed environment at various temperatures and pressures. Author

N72-21915# Frankford Arsenal, Philadelphia, Pa.
**TENSILE LIGAMENT INSTABILITY AND THE GROWTH OF STRESS CORROSION CRACKS IN A HOMOGENEOUS Xn-Mg-Cu ALUMINUM ALLOY**
Joseph H. Mulherin *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 7 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

The application of the Krafft tensile ligament model to the stress corrosion phenomenon of a homogeneous Zn-Mg-Cu aluminum alloy is discussed. The variant in the series was the degree of homogeneity of the microstructure. According to the model, the largest variation in the susceptibility to stress corrosion crack propagation was attributable to an increase in the rate of surface chemical attack around the circumference of the ligaments. Author

**N72-21916#** North American Rockwell Corp., Thousand Oaks, Calif. Science Center.

**AN ULTRA-HIGH VACUUM SYSTEM FOR DETERMINING THE EFFECTS OF GASEOUS ENVIRONMENTS ON FATIGUE AND FRACTURE PROPERTIES OF METALS** **c14**

H. L. Marcus and P. J. Stocker *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 8 p refs (See N72-21900 12-32)

Avail: NTIS HC $6.00/MF $0.95

A high vacuum, 10 to the minus 10th power torr, all-metal system is described in which crack growth behavior of metals under static and dynamic loading can be studied. Provisions are made to introduce clean gases to the system, such as hydrogen and oxygen to study their effects on the crack growth phenomena. Crack growth results are presented for Ni-200 exposed to low pressures of hydrogen gas in the 10 to the minus 8th power to 150 torr pressure range. Author

**N72-21917#** Ohio State Univ., Columbus. Dept. of Metallurgical Engineering.

**ACOUSTIC EMISSIONS AND SLOW CRACK GROWTH IN HIGH STRENGTH STEEL** **c14**

R. W. Staehle and G. E. Kerns *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 12 p refs (See N72-21900 12-32)

Avail: NTIS HC $6.00/MF $0.95

Acoustic emission techniques were used to study stress corrosion cracking in high strength material. Pre-fatigue cracked single cantilever specimens were loaded and exposed to gaseous and aqueous environments. Acoustic emission signal shape and total resonance counts were recorded for specimens of different strength levels tested in different environments. Also, the phenomenon of wave reflection was reduced in order to examine the frequency content and energy of the emission. The results show that a higher strength level produces more acoustic activity, regardless of environment. Also, the generated stress wave is of a high frequency and low energy nature. Author

**N72-21918#** Fiat S.p.A., Turin (Italy). Lab. Auto Avio.

**A CONTRIBUTION TO STRESS CORROSION TESTING OF ALUMINUM ALLOYS** **c14**

Giovanni Bollani *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 13 p refs (See N72-21900 12-32)

Avail: NTIS HC $6.00/MF $0.95

The results of an extensive investigation for the improvement of the stress corrosion testing methods on high strength Al alloys are briefly outlined. For the evaluation of the crack initiation period under different stress conditions, two smooth specimens of original design are recommended. For the measure of the crack propagation rate, the D.C.B. (Double Cantilever beam) pre-cracked specimen was found effective. Author

**N72-21919#** Naval Ship Research and Development Center, Annapolis, Md. Corrosion Branch.

**INFLUENCE OF TEST METHOD ON STRESS CORROSION BEHAVIOR OF ALUMINUM ALLOYS IN SEA WATER** **c17**

George J. Danek *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 11 p refs (See N72-21900 12-32)

Avail: NTIS HC $6.00/MF $0.95

Highlights are presented of recent investigations on sea water stress corrosion behavior of high strength aluminum alloys. Rolled 7000-series plate was used to show a significant influence of specimen orientation on sea water stress corrosion response. The results suggested that tests in the short transverse direction are essential in ascertaining stress corrosion behavior of high strength aluminum alloys in either smooth or precracked specimens. Based on these results a number of high strength hand forgings, representing the 2000-, 6000-, and 7000-series, were tested as bent-beam and precracked cantilever specimens taken in the short transverse direction. Inconsistencies are observed when the sea water stress corrosion results from precracked cantilever specimens are compared to those from smooth specimens. The results indicate that each of the two techniques provides important information, and both methods should be used in assessing the sea water stress corrosion behavior of high strength aluminum alloys. Author

**N72-21920#** Aluminum Co. of America, Pittsburgh, Pa. Chemical Metallurgy Div.

**DISCUSSION OF PAPER, INFLUENCE OF TEST METHOD ON STRESS CORROSION BEHAVIOR OF ALUMINUM ALLOYS IN SEAWATER BY GEORGE J. DANEK** **c17**

Donald O. Sprowls and J. G. Kaufman *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 7 p refs (See N72-21900 12-32)

Avail: NTIS HC $6.00/MF $0.95

It is shown that the method of testing with precracked specimens may be affected as much, or more, than traditional smooth specimen methods. On the basis of estimated threshold stress intensities obtained with precracked cantilever beam specimens, rankings of alloys are reported that are unrealistic compared to service experience and estimated threshold stresses obtained from tests of smooth beam specimens. Tests of the same alloys with bolt-loaded precracked double cantilver beam specimens ranked the alloys in good agreement with rankings obtained from tests of smooth tensile specimens. Author

**N72-21921#** Societe Nationale Industrielle Aerospatiale, Paris (France).

**PARTICIPATION OF THE STUDY OF CORROSION UNDER TENSION OF CERTAIN HIGH RESISTANCE ALUMINUM ALLOYS [PARTICIPATION A L'ETUDE DE LA CORROSION SOUS TENSION DE CERTAINS ALLIAGES D'ALUMINUM A HAUTE RESISTANCE]** **c14**

Robert Doste *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 15 p In FRENCH (See N72-21900 12-32)

Avail: NTIS HC $6.00/MF $0.95

Experiments were conducted on corrosion under tension of two of the principal aluminum alloys used in the French aircraft industry: A-U2GN and A-U4SG. A number of systematic tests were made using classical tests methods, under conditions of flexure, with a constant imposed load. Processes occurring during corrosion and stress corrosion are most often electrochemical reactions, and certain study techniques are described for electrochemical methods, in order to establish a correlation between observed phenomena and the particular microstructures of the alloys. In the case of the a-U2GN alloy, an explanation is advanced based on sensitivity to intercrystalline corrosion and the role of constraint, as well the desensitizing which occurs after proper heat treatment. Heat treatment of the alloy A-U4SG diminishes the susceptibility of the material to intercrystalline corrosion, while sensitivity to stress corrosion remains significant. The influence of aeration on the solution appears to be of major importance. Transl. by K.P.D.

**N72-21922#** Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).

**RESULTS OF COMPARATIVE STRESS CORROSION TESTS ON AlZnMgCu-ALLOYS USING DIFFERENT TYPES OF SPECIMENS**

Werner Lehmann *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 15 p (See N72-21900 12-32)

Avail: NTIS HC $6.00/MF $0.95

In order to evaluate and to compare the stress corrosion behavior of more complicated structural parts, for example die forgings from the two different alloys 7079-T6 and AZ 74.61, various types of specimens were taken from critical locations on the forging. These locations are the area around the jack point hole, the main parting plane, and the area of the first two rows of bolt holes. C-rings, precracked DCB specimens, and smooth tension specimens were examined, using a standard 3.5 %-NaCl

alternate immersion test. The test specimens were periodically inspected in order to find out the time to failure (tension specimens), the time to the first crack or to complete fracture (C-rings), and the crack length as a function of time as well as the threshold stress value (DCB specimens). The results show that forgings from the alloy AZ 74.61 are superior to those of 7079-T6. Author

**N72-21923#** Carpenter Technology Corp., Reading, Pa.
**STRESS CORROSION CRACKING OF MARTENSITIC PRECIPITATION HARDENING STAINLESS STEELS** c17
Michael Henthorne *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 8 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

Stress corrosion cracking tests on two precipitation-hardened stainless steels, Custom 455 and Custom 450, were used to study the effects of heat treatment, product size, type of test specimen, and test environment. Smooth specimens (tensile, bent beam and U-bend) and precracked cantilever beams were tested in sodium chloride solution, salt spray, and a natural marine atmosphere. The cracking resistance of Custom 455 improves significantly as the aging temperature is increased, i.e. as the yield strength decreases and the toughness increases. Specimens cut from large product sizes (e.g. billet) have lower fracture toughness than smaller sizes (e.g. bar). The differences between stress corrosion and cracking in galvanic corrosion situations are discussed. Author

**N72-21924#** Societe Nouvelle des Acieries de Pompey (France).
**INVESTIGATION OF AN ACCELERATED STRESS CORROSION CRACKING METHOD**
M. Hugo, J. Bellot, and E. Herzog *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 11 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

An accelerated slow strain rate tensile method of testing is suggested which may be useful for inspection purposes. Slow straining in nitrate, NaOH, and acid environments are described. Author

**N72-21925#** United States Steel Corp., Monroeville, Pa. Applied Research Lab.
**MICROSCOPIC IDENTIFICATION OF STRESS CORROSION CRACKING IN STEELS WITH HIGH YIELD STRENGTH**
E. H. Phelps *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 14 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

The microscopic features of stress corrosion cracking in steels with high yield strength are reviewed with the objective of establishing specific characteristics by which stress corrosion can be identified. Photomicrographs of stress corrosion cracking obtained under known exposure conditions on specimens of alloy steels, of precipitation-hardenable stainless steels, and of maraging steels are presented and discussed. The most consistent feature of stess corrosion cracking in these steels is that it usually is initiated at multiple sites on the steel surface. Cracking may be intergranular or transgranular, depending on the alloy system and the environment. Branching occurs in some instances but is not a consistent characteristic of stress corrosion cracking in steels with high yield strength. Author

**N72-21926*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**HOT SALT STRESS CORROSION CRACKING OF TITANIUM ALLOYS: OVERVIEW AND IMPACT ON SPACE SHUTTLE APPLICATION** c17
W. Barry Lisagor and James E. Gardner *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 10 p refs (See N72-21900 12-32)
(NASA-TM-X-68304) Avail: NTIS CSCL 11F

The test program described was conducted to determine if onset of hot salt stress corrosion cracking would occur in the cumulative exposure of time, temperature, and stress currently considered for titanium heat shields in the shuttle mission. In addition, efforts were made to assess the effects of cyclic exposure on cracking, to compare the resistance to cracking of the two proposed prime candidate alloys (Ti-6A1-4V and Ti-6A1-2Sn-4Zr-2Mo) and to determine the effect of Mach 3 airflow on cracking behavior. The results indicate that cracking will occur on salt coated specimens continuously exposed in laboratory ovens for 100 hours at temperatures and stresses proposed for shuttle TPS application. However, both cyclic exposure and exposure in a Mach 3 airstream tend to decrease the damage observed. The Ti-6Al-4V alloy exhibited a higher threshold stress than the Ti-6Al-2Sn-4Zr-2Mo alloy but suffered more apparent damage once onset of cracking occurred. Author

**N72-21927#** Battelle Memorial Inst., Columbus, Ohio. Corrosion Research Div.
**THE USE OF SLOW STRAIN RATE EXPERIMENTS IN EVALUATING RESISTANCE TO ENVIRONMENTAL CRACKING** c17
James E. Reinoehl and Walter K. Boyd *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 5 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

An experimental procedure is described for evaluating resistance to stress corrosion cracking. Relative degrees of susceptibility to environmental cracking and embrittlement can be determined as a function of mechanical ductility (parameters reduction in area, elongation, etc.) or as a function of electrochemical polarization parameters electrode potential, pH, solution composition, etc.) by pulling cylindrical tensile specimens at a slow strain rate, while they are subjected to controlled electrochemical and environmental conditions (electrode potential, solution composition, temperature, etc.). Author

**N72-21928#** Lockheed-California Co., Burbank. Materials Research Lab.
**EXPERIMENTAL TECHNIQUES USED TO STUDY STRESS CORROSION MECHANISMS IN AIRCRAFT STRUCTURAL ALLOYS**
G. M. Hoch, W. E. Krupp, and K. E. Weber *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 10 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

Various techniques for the study of crack morphology, contaminant identification, and electrochemistry are considered. These include the use of time lapse photography, transmission and scanning electron microscopy, introduction of radioactive elements into the corrosive media under study, and pH and oxidation-reduction indicators. K.P.D.

**N72-21929#** Ecole des Mines, Paris (France).
**FRACTURE INITIATION AND STRESS CORROSION CRACKING OF WELDED JOINTS OF ALPHA TYPE TITANIUM ALLOYS**
C. Chassian and P. R. Krahe *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 6 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

The almost instantaneous failure of some welded joints of certain Ti-Al-Sn alpha-type alloys when in contact with carbon tetrachloride vapor, was studied and related to the slight surface contamination developed during argon arc welding. Analysis of the contaminated layers with the Castaing-Slodzian ion probe showed that a substantial amount of oxygen penetration had occurred during the welding operation. Testing showed that the susceptibility to stress corrosion was related to the extent of this penetration and microcracks were observed to form on the welded surfaces after loading, but before contact with the corrosion medium. As oxygen in solid solution in titanium reduces its ductility, these mechanical cracks propagate under

the action of a constant load deeper into the more contaminated samples. Author

**N72-21930#** Istituto di Ricerche Breda S.p.A., Milan (Italy).
**PRELIMINARY REPORT ON THE RESEARCH ON THE INFLUENCE OF THERMOMECHANICAL TREATMENTS ON STRESS CORROSION CRACKING BEHAVIOUR OF AISI 4340 STEEL** c17
R. DeSantis, L. Matteoli, and T. Songa *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 5 p refs (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

Two grades of 4340 AISI steel were selected: air-melted and electroslag-remelted. Experimental results are presented which were obtained by testing the hardness of two specimens of both steel grades subjected to thermomechanical treatments. The hardness recovery of the steels tempered at 200 C is very small, if not absent, and sometimes it takes place after a very long tempering time. This phenomenon is very marked for the 300 C-tempered steels. In this case long tempering time causes a second decrease of the hardness in a way typical for aging phenomena. No clear relation seems to exist between the metallurgical grade of the material and the behavior upon deformation and second tempering. Moreover there were significant differences in the results obtained on different specimens of the same material. Author

**N72-21931#** Istituto Sperimentale del Metalli Leggeri, Novara (Italy). Metallurgy Dept.
**PRELIMINARY RESULTS OF MECHANICAL AND STRESS CORROSION TESTS ON PLATES OF 7075 ALLOY PRODUCED BY A NEW PROCESSING TECHNIQUE**
E. DiRusso, M. Conserva, and M. Buratti *In* AGARD Specialists Meeting on Stress Corrosion Testing Methods Jan. 1972 6 p (See N72-21900 12-32)
Avail: NTIS HC $6.00/MF $0.95

The primary and secondary properties of hot rolled plates of 7075 alloy are briefly described. The materials show a reduction of the transverse effect, compared to conventionally produced plates. Improved characteristics of ductility, fracture toughness and stress corrosion resistance were attained in the short transverse direction, along with strength levels equal to or higher than those of similar materials produced in the traditional way. Author

**N72-21932*#** Pennsylvania Univ., Philadelphia.
**THEORY OF FIBER REINFORCED MATERIALS**
Zvi Hashin Washington NASA Mar. 1972 705 p refs
(Contract NAS1-8818)
(NASA-CR-1974) Avail: NTIS HC $9.00/MF $0.95 CSCL 20K

A unified and rational treatment of the theory of fiber reinforced composite materials is presented. Fundamental geometric and elasticity considerations are throughly covered, and detailed derivations of the effective elastic moduli for these materials are presented. Biaxially reinforced materials which take the form of laminates are then discussed. Based on the fundamentals presented in the first portion of this volume, the theory of fiber-reinforced composite materials is extended to include viscoelastic and thermoelastic properties. Thermal and electrical conduction, electrostatics and magnetostatics behavior of these materials are discussed. Finally, a brief statement of the very difficult subject of physical strength is included. Author

**N72-21933*#** Midwest Applied Science Corp., Lafayette, Ind.
**INVESTIGATION OF THE UTILITY OF MEAN SQUARE APPROXIMATION SYSTEMS AND IN SYSTEM RESPONSE PREDICTIONS**
J. L. Bogdanoff and A. J. Schiff Washington NASA Mar. 1972 120 p refs
(Contract NAS5-11541)
(NASA-CR-1961; MASC-215F) Avail: NTIS CSCL 20K

A method is presented for estimating the variability of a system's natural frequencies arising from the variability of the system's parameters. The only information required to obtain the estimates is the member variability, in the form of second order properties, and the natural frequencies and mode shapes of the mean system. Several examples are worked out in detail to illustrate how the method is applied. Author

**N72-21934#** Royal Aircraft Establishment, Farnborough (England).
**THE INFLUENCE OF GRAIN SIZE ON THE STRESS-STRAIN RELATIONSHIP OF TENSILE TESTED fcc METALS**
Z. Jasienski and S. Wierzbinski Nov. 1971 28 p refs Transl. into ENGLISH from Arch. Hutnictwa (Warsaw), v. 15, no. 1, 1970 p 27-54
(RAE-Lib-Trans-1585; BR-28525) Avail: NTIS

Investigations carried out on aluminum, copper, and brass show that the stress-strain relationship for these fcc materials in the range of uniform elongation is in agreement with the exponential equation sigma = kz sub i to the mth power, based on the concept of a latent strain z sub I. A deviation from the assumed function sigma - f(z sub i) at stages prior to necking depends on the degree of the heterogeneity of the metal. The initial range of strain hardening was found to be dependent on grain size. The influence of grain size for all three materials obeys the Petch equation. Author

**N72-21935#** Technische Hochschule, Darmstadt (West Germany). Lehrstuhl fuer Leichtbau.
**STABILITY INVESTIGATIONS OF PLATES USING FINITE ELEMENT METHOD BASED ON AN EXPANDED VARIATION PRINCIPLE [FINITE ELEMENTE ZUR STABILITAET-SUNTERSUCHUNG VON PLATTEN AUF DER GRUNDLAGE EINES ERWEITERTEN VARIATIONSPRINZIPS]**
M. Link Cologne DGLR 1971 22 p refs In GERMAN Presented at the 4th DGLR Annual Meeting, Baden-Baden, West Ger., 11-13 Oct. 1971
Avail: NTIS

Structural stability and stress of elastic plates were investigated using the finite element method based on an expanded variational principle and matrix displacement method. The accuracy in applying the finite element method depends on the number of elements chosen, and the accuracy of element description. It is shown how theoretically exact elements can be produced using a theory based on an expanded principle of the stationary value of the potential energy. Included are the elemental geometrical stiffness under a constant basic stress situation, and the possibility of applying stability or stress investigations after second order theory. Applications to elastic plates are shown, and examples of square elastic plates, including one buckling case, are calculated. ESRO

**N72-21936#** California Univ., Berkeley. Div. of Structural Engineering and Structural Mechanics.
**A COMPUTER PROGRAM FOR ANALYSIS OF STIFFENED PLATES UNDER COMBINED INPLANE AND LATERAL LOADS**
Dag Kavlie and Ray W. Clough Mar. 1971 71 p refs
(Contract N00014-69-A-0200-1045; SF Proj. 013-03-01)
(AD-735936; UCSESM-71-4) Avail: NTIS CSCL 20/11

The finite element method is used as the basis of computer program for analysis of stiffened plates. Triangular and quadrilateral plate elements and beam elements may be used for idealization of the stiffened plates. The plate elements may have isotropic or orthotropic material properties. The stiffeners are assumed to be symmetric about the midplane of the plate. This assumption uncouples the plane stress and the plate bending problems. If the inplane stresses are not known in advance, the plane stress problem can be solved as a first step. The next step may be to solve the plate bending problem. The effect of the membrane stresses on the plate bending behavior is taken care of in this case by adding the geometric stiffness matrix to the elastic stiffness matrix. Alternatively the stability problem may be

solved, finding the critical buckling eigenvalue and the corresponding mode shape. A listing of the FORTRAN IV computer program is given in the report, and a few examples of bending and buckling of stiffened plates are presented. The program has been developed and tested on the CDC 6400 computer. Author (GRA)

N72-21937# California Univ., Berkeley. Div. of Applied Mechanics.
**A UNIQUENESS THEOREM IN THE THEORY OF COSSERAT SURFACE**
P. M. Naghdi and J. A. Trapp Nov. 1971 35 p refs
(Contract N00014-69-A-0200-1008; NR Proj. 064-436)
(AD-735927; AM-71-5) Avail: NTIS CSCL 20/11

Within the scope of the non-isothermal theory of an elastic Cosserat surface and for a system of linear equations characterizing the initial mixed boundary-value problems of thermoelastic shells, a uniqueness theorem is obtained without the use of definiteness assumption for the free energy. The theorem holds for nonhomogeneous and anisotropic shells undergoing small motions (and small temperature change) superposed on a large deformation. Author (GRA)

N72-21938# California Univ., Berkeley. Structural Engineering Lab.
**NONLINEAR ANALYSIS OF PLATES CONSIDERING GEOMETRIC AND MATERIAL EFFECTS**
Pal G. Bergan Apr. 1971 184 p refs
(Contract N00014-69-A-0020-1045; SF Proj. 013-03-01)
(AD-735937; UCSESM-71-7) Avail: NTIS CSCL 20/11

The purpose of this investigation is to study nonlinear behavior of plates considering both geometric and physical nonlinearities. Large deflections are accounted for using the von Karman strain expressions for plates and initial deformations are considered using the Marquerre shallow shell theory. Establishing the variational principles, the equilibrium and incremental equations for general Rayleigh-Ritz type solution methods are derived. The finite element method is adopted for the numerical solution of the problem. Different general numerical techniques for solving nonlinear structural problems are considered. The problems of convergence and accuracy of iteration methods are also discussed. A wide range of numerical examples are presented, such as large deflections of different plates, post buckling behavior of plates, snap-through problems and inelastic behavior of various plates. Author (GRA)

N72-21939# Watervliet Arsenal, N.Y.
**NONCLASSICAL FORCED MOTION OF STATIONARY AND ROTATING BEAMS WITH TIP MASSES**
Struan Robertson Sep. 1971 37 p refs
(AD-735683; WVT-7145) Avail: NTIS CSCL 20/11

A formal solution, using Williams' superposition principle, is given for the non-classical forced motion problems of stationary and rotating beams with tip masses, where the coupling of flexure and torsion is included in the governing equations. Author (GRA)

N72-21940# Craig Systems, Inc., Lawrence, Mass.
**DESIGN, FABRICATION, AND TESTING OF A SHELTER NOMENCLATURED SHELTER, ELECTRICAL EQUIPMENT S-508/G Final Report, Jun. 1970 - Apr. 1971**
Lon A. Williams Nov. 1971 91 p refs
(Contract F30602-70-C-0287; DR Proj. 70-8)
(AD-735280; TR-249; RADC-TR-71-242) Avail: NTIS CSCL 13/13

The primary objective of the program was to provide RADC an electronic-equipment shelter that successfully meets and exceeds the S-280/G requirements and is far more versatile for equipment installation. Detailed objectives were to: (1) Provide equipment mounting capability between the panel members and in the panel members of a foam-and-beam shelter. The insert installation was to be the Craig Model 555 Mounting System, which had been developed under a company-funded development program. (2) Provide a safeguard against delamination of the outer skin. (3) Maintain reasonable weight, while meeting S-280/G size and performance requirements. Author (GRA)

N72-21941# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
**AN ASSESSMENT OF CURRENT CAPABILITY FOR COMPUTER ANALYSIS OF SHELL STRUCTURES Final Report, Apr. 1969 - Apr. 1971**
Richard F. Hartung Wright-Patterson AFB, Ohio AFFDL Apr. 1971 246 p refs
(Contract F33615-69-C-1523; AF Proj. 1467)
(AD-735726; AFFDL-TR-71-54) Avail: NTIS CSCL 20/11

The report contains an assessment of current shell analysis capability. The assessment is based on work conducted at the Lockheed Palo Alto Research Laboratory under contract to the Air Force Flight Dynamics Laboratory. In addition to surveying the open literature, information for the study was gathered during a series of visits made to organizations throughout the United States at which there is an active shell analysis research effort. More than 40 industrial concerns, government agencies and universities have been visited to date. During each visit, technical personnel working in the area of shell analysis were interviewed to determine the scope of their present analysis capability, to learn of current research activities and to discuss computer methods of shell analysis in general. Information so obtained is summarized in a series of briefs which appear in the Appendix of this report. Author (GRA)

N72-21942# Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
**ON THE EFFECT OF PORE PRESSURES ON SOIL-WHEEL INTERACTION**
Leslie L. Karafiath Dec. 1971 40 p refs Presented at 4th Intern. Conf. for Terrain Vehicle Systems, Stockholm, 24-28 Apr. 1972
(AD-735792; RM-528J) Avail: NTIS CSCL 08/13

Wheel loads generate pore pressures in soils when their moisture content exceeds a certain level. These pore pressures affect the development of failure zones that control interface stresses in soft soils. The differential equations of plasticity governing the geometry of failure zones have been expanded to account for pore pressures and appropriate algorithms developed for the numerical solution of these equations. Slip-line field geometries and wheel performance parameters are shown in an example for various degrees of shear mobilization and sore pressure parameters. The effect of pore pressures on wheel performance is considerable even in soils with weak pore pressure response. Author (GRA)

N72-21943# Naval Ship Research and Development Center, Bethesda, Md.
**AN EVALUATION OF FINITE ELEMENT METHODS FOR THE COMPUTATION OF ELASTIC STRESS INTENSITY FACTORS Final Report**
John J. Oglesby and Oles Lomacry Dec. 1971 81 p refs
(SF Proj. 35-422-210)
(AD-735874; NSRDC-3751) Avail: NTIS CSCL 20/11

The report summarizes the first phase of the development of computer programs for calculating elastic stress intensity factors at the critical (fatigue-prone) details of pressure hulls. The work is part of a broader study aimed at the development of analytical methods for fatigue and fracture analysis of submarine hulls. Two new techniques are introduced. One is based on direct application of the linear elastic fracture mechanics relations between the stress intensity factors and the near crack tip displacement fields utilizing two-term series expansion. The stress intensity factors are computed directly from the nodal displacements obtained previously from the finite element program. The second technique is based on direct incorporation into the finite element computer program of the strain energy of the singular element enclosing the crack tip. Examples of the

application of such methods to several simply axisymmetric and two-dimensional plane strain problems are presented along with recommendations for future studies and applications.
Author (GRA)

**N72-21944#** Naval Ship Research and Development Center, Bethesda, Md.
**RADIATION FROM FREE-FREE BEAMS UNDER INFLUENCES OF LIGHT AND HEAVY FLUID LOADING**
William K. Blake Nov. 1971 40 p refs
(SF Proj. 35-452-007)
(AD-735873; NSRDC-3716) Avail: NTIS CSCL 20/11

The acoustic radiation from a series of free-free, point driven beams has been studied both analytically and experimentally. The investigations have shown the dependence of acoustic power on beam geometry and on beam density relative to fluid density. The radiated power due to a prescribed transverse beam motion was analytically predicted by modeling the beam as a finite, long, slender strip with a thin elliptical cross-section. The neutral axis and the section major axis were coincident. Two extremes of baffled (no fluid motion across the plane coincident with the beam major axis) and unbaffled (fluid motion permitted across that plane) beams are discussed analytically. Experimental verification in the form of measurements of radiated power relative to mean-square beam velocity is provided.
Author (GRA)

**N72-21945#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**EQUIPMENT FOR TESTING WELDED SEAMS OF THIN-WALLED SHELLS**
E. S. Milekhin and L. P. Telyatnikov 17 Aug. 1971 16 p refs Transl. into ENGLISH from Tr. Mosk. Vysshee Tekhn. Uchilishche (Moscow), no. 133, 1969 p 119-128
(Contract F33657-71-D-0057)
(AD-735925; FTD-HC-23-739-71) Avail: NTIS CSCL 13/5

Experimental work performed on a laboratory stand confirmed the effectiveness of the process for checking the welded seams using the method of high-speed deformation and made it possible to construct an experimental test stand for rolling welded seams (Model SVPS).
Author (GRA)

**N72-21946#** Pennsylvania State Univ., University Park. Dept. of Engineering Mechanics.
**FINITE ELEMENTS FOR SHOCK ANALYSIS Progress Report, Apr. - Sep. 1971**
V. H. Neubert Sep. 1971 101 p refs
(Contract N00014-67-A-0385-0010)
(AD-735923; PR-2) Avail: NTIS CSCL 20/11

Finite elements are summarized as developed for bars, shafts in torsion, Bernoulli-Euler beams and Timoshenko beams. The elements were derived as black boxes which would have correct modal forces or impedances correct at the terminal points. The elements as presented may be used directly in most existing computer programs for shock and vibration analysis of structures.
Author (GRA)

**N72-21947#** Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
**THE BUCKLING OF STIFFENED AND UNSTIFFENED SHELL STRUCTURES Final Report**
Josef Singer Nov. 1971 30 p refs
(Contract F61052-69-C-0040; AF Proj. 9782)
(AD-736044; TAE-139; AFOSR-72-0232TR) Avail: NTIS CSCL 20/11

Theoretical and experimental research on the buckling of stiffened and unstiffened cylindrical and conical shells, and arches and rings is summarized. The topics of earlier work are outlined and the more recent topics are summarized. These include: the influence of in-plane boundary conditions for stringer and ring-stiffened cylindrical shells, extensive tests on integrally stringer-stiffened and ring-stiffened cylindrical shells under axial compression, thermal buckling of cylindrical shells, a collocation method for buckling analysis of elastically restrained conical shells, buckling of cylindrical panels under non-uniform axial compression, and instability of closely ring-stiffened conical shells.
Author (GRA)

# 33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

**N72-21948** National Lending Library for Science and Technology, Boston Spa (England).
**FORMATION AND EVOLUTION OF NITROGEN OXIDES IN INTERNAL COMBUSTION ENGINES**
X. Lys 12 Jan. 1971 15 p refs Transl. into ENGLISH from report of Inst. Francais du Petrole
(NLL-M-22139-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

A mathematical model was developed describing the variations in aerodynamic, chemical, and thermal properties at the core of the internal combustion engine, combustion chamber. A thermodynamic theory and kinetic theories of NO formation are applied to this model. The diesel engine is also compared to the internal combustion engine.
J.A.M.

**N72-21949** National Lending Library for Science and Technology, Boston Spa (England).
**NUCLEATE BOILING HEAT TRANSFER IN BINARY LIQUID MIXTURES**
H. Takeda, T. Hayakawa, and S. Fujita Sep. 1971 8 p refs Transl. into ENGLISH from Kagaku Kogaku (Japan), v. 34, no. 7, 1970 p 751-755
(NLL-LB/G/3091-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Five catagories of pure liquids and ten catagories of mixed liquids were employed as the boiling liquids. Experiments on pool saturation nucleate boiling heat transfer were performed, using copper plate and platinum wire as heating surfaces. Empirical equations were used as coefficients of heat transfer.
Author

**N72-21950** National Lending Library for Science and Technology, Boston Spa (England).
**ABSOLUTE ANALYSIS OF THE THERMAL CONDUCTIVITY OF ARGON IN THE SHOCK TUBE Ph.D. Thesis**
Rainer Ewald [1971] 43 p refs Transl. into ENGLISH from thesis report from Rheinland-Westfalen Tech. Univ., Aachen, West Germany
(NLL-M-22129-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 4 NLL photocopy coupons

Basic equations are presented for the temperature boundary layer, and for operation of an ionized gas interferometer. The experimental arrangement is described for the shock wave tube. Sources of error include Mach number and pressure measurements, scale of photographic reproduction, adjustment of the optical axis, density gradient, gas composition, limited width of interference strips, boundary layer thickness, shading effect, time and space derivations, and radiation flow. Direct measurements of the heat conductivity of argon were obtained at approximately 5000 K.
K.P.D.

**N72-21951** National Lending Library for Science and Technology, Boston Spa (England).
**HEAT EXCHANGERS OF COMPACT DESIGN**

H. Kremer and E. Scholand [1971] 26 p refs Transl. into ENGLISH from Gas-Waerme (Essen), v. 20, no. 5, May 1971 p 189-195 In GERMAN and ENGLISH
(NLL-M-22137-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

Gas heat transfer in heat exchangers is considered. The fundamental designs of individual types of heat exchangers are discussed. Methods of improving heat transfer by developing an optimum boundary layer are reviewed. These include increasing turbulence, increasing heat transfer by rough surfaces, and extension of the heat exchanger surface. Manufacturing methods, choice of material and the use of noncircular tubes in compact heat exchangers are also considered. The relationships between the amounts of heat transferred, heat exchange areas, design volumes, and manfacturing and operating costs are presented.
K.P.D.

**N72-21952*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**OPTICAL PROPERTIES OF THERMAL CONTROL COATING CONTAMINATED BY MMH/N2O4 5-POUND THRUSTER IN A VACUUM ENVIRONMENT WITH SOLAR SIMULATION**
R. D. Sommers, C. A. Raquet, and J. F. Cassidy 1972 16 p refs Presented at 7th Thermophys. Conf., San Antonio, 10-12 Apr. 1972; sponsored by AIAA
(NASA-TM-X-68044; E-6881) Avail: NTIS CSCL 20M

Cat-a-lac Black, and S13G thermal control coatings were exposed to the exhaust of a thruster in a simulated space environment. Vacuum was maintained at less than 10 to the minus 5th power torr during thruster firing in the liquid helium cooled facility. The thruster was fired in a 50-millisecond pulse mode and the accumulated firing time was 224 seconds. Solar absorptance (alpha sub s) and thermal emittance (sigma) of the coatings were measured in-situ at intervals of 300 pulses. A calorimetric technique was used to measure alpha sub s and sigma. The tests, technique, and test results are presented. The Cat-a-lac Black coatings showed no change in alpha sub s or sigma. The S13G showed up to 25 percent increase in alpha sub s but no change in sigma.
Author

**N72-21953*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**DIFFUSIVE AND RADIATIVE EFFECTS ON VAPORIZATION TIMES OF DROPS IN FILM BOILING**
Kenneth J. Baumeister and Glen J. Choessow 1972 30 p refs Proposed for presentation at 13th Natl. Heat Transfer Conf., Denver, 6-9 Aug. 1972; sponsored by Am. Inst. of Chem. Engr. and ASME
(NASA-TM-X-68037; E-6867) Avail: NTIS CSCL 20M

Diffusive and radiative effects are incorporated into an analysis for the vaporization time of drops in film boiling. The momentum, energy, and continuity equations are solved with some appropriate simplifications so as to obtain a simple closed form solution for the overall film boiling heat transfer coefficient. Next, a theoretical expression for the droplet vaporization time is developed and compared to the measured vaporization times of water droplets vaporizing into air, argon, nitrogen, and helium. The agreement between experiment and theory is good. Under the helium blanket, the diffusive evaporative component is significant in comparison to the film boiling component.
Author

**N72-21954*#** Martin Marietta Corp., Denver, Colo.
**STUDY OF CRITICAL DEFECTS IN ABLATIVE HEAT SHIELD SYSTEMS FOR THE SPACE SHUTTLE**
R. L. Thompson, W. D. Rummel, and W. E. Driver Washington NASA Apr. 1972 145 p
(Contract NAS1-10289)
(NASA-CR-2010; MCR-71-233) Avail: NTIS CSCL 20M

Results are presented from an investigation to determine the effects of fabrication-induced defects on the performance of an ablative heat shield material in a simulated space shuttle reentry environment. Nondestructive methods for detecting the defects were investigated. The material considered is a fiber-filled, honeycomb-reinforced, low-density elastomer. Results were obtained for density variations, voids, fiber bundles, crushed honeycomb, undercut honeycomb, unbonded areas, face sheet delaminations, and cure variations. The data indicate that, within reasonable tolerances, the fabrication defects investigated are not critical in terms of reentry performance of the heat shield.
Author

**N72-21955*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**LINEAR EXPLOSIVE COMPARISON Patent Application**
Laurence J. Bement, inventor (to NASA) Filed 17 Jun. 1971 17 p
(NASA-Case-LAR-10800-1; US-Patent-Appl-SN-154094) Avail: NTIS CSCL 19A

An apparatus and method for quantitatively determining the performance of linear explosives, mild detonating fuze, and flexible linear shaped charges are described. The test results are obtained by test firing 45.7 centimeter lengths of linear explosives, obtaining simultaneous energy output of the explosive, measurements of the velocity of propagation, and the cutting or rupturing ability in a tapered aluminum plate. The accuracies of the energy output measurements of the explosives are substaniated by comparison with their heats of detonation.
NASA

**N72-21956*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**ABLATION ARTICLE AND METHOD Patent Application**
Wayne D. Erickson and Edward M. Sullivan, inventors (to NASA) Filed 20 Sep. 1971 13 p
(NASA-Case-LAR-10439-1; US-Patent-Appl-SN-182033) Avail: NTIS CSCL 20M

A system for analyzing the effects of ablation conditions on an ablating surface is described. The system consists of sensors in the form of seed materials provided on the ablation surface. When the surface is submitted to ablating conditions, the radiation emanating from the seed materials ablated from the surface is detected. The radiation intensity is dependent on the amount of seed material ablated, which in turn is a function of the ablation conditions. A change in radiation intensity can be used to detect a change from laminar to turbulent flow in the boundary layer over the ablating surface.
NASA

**N72-21957#** Brookhaven National Lab., Upton, N.Y.
**EFFECT OF NONUNIFORM HEAT FLUX ALONG THE CHANNEL LENGTH ON THE CRITICAL HEAT FLUX FOR BOILING POTASSIUM IN TUBES**
I. T. Aladev, I. G. Gorlov, and O. S. Fedynskii [1971] 11 p refs Transl. into ENGLISH from the publ. "Teplo-Massoperenos v Odno- i Dvukfaznykh Sredakh" Moscow, Izdatelstvo Nauka, 1971 p 5-9 Sponsored by AEC
(BNL-TR-458) Avail: NTIS

Results are reported of an experimental study of the critical heat flux with both decreasing and increasing axial heat flux for potassium boiling crisis in tubes. The working parameters for the experiment are given, and the findings are summarized. It is concluded: (1) The critical heat flux decreases with increasing channel length. (2) Under certain conditions the crisis does not occur. (3) The critical heat flux and the location of the crisis point depends on the heat flux distribution along the perimeter and length of the channel.
F.O.S.

**N72-21958#** Oak Ridge National Lab., Tenn.
**REFERENCE DESIGN FOR A THERMOELECTRIC ISOTOPE POWER UNIT EMPLOYING HEAT PIPE MODULES**
A. P. Fraas and M. E. LaVerne Nov. 1971 58 p refs
(Contract W-7405-eng-26)
(ORNL-Tm-2959) Avail: NTIS

This reference design makes use of potassium heat pipes to transport heat to thermoelectric modules from the same basic

heat block-shield assembly as would be used for the organic and steam Rankine cycle systems of this program. The heat block-shield employs seven capsules of Sr-90 in the form of SrTiO3 encased in Hastelloy. Designs for both iron and nickel heat block-shield units were prepared. Twelve thermoelectric modules; each with a 1-in. diameter, 79-in. long heat pipe, are designed to produce 167 W each at 24 V. They can be coupled in a series-parallel arrangement to yield 2 kW(e) at 48 V. The design is based on lead telluride thermoelectric junctions, but is equally well suited to use with advanced materials yielding a higher efficiency when these become available. The design studies were extended to include an investigation of the improvement in performance that might be obtained with the new TPM-217 thermoelectric material under development at the 3M Company. Author (NSA)

**N72-21959#** Minnesota Univ., Minneapolis. Heat Transfer Lab.
**EXPERIMENTS ON A SHROUDED, PARALLEL DISK SYSTEM WITH ROTATION AND COOLANT THROUGH-FLOW**
J. P. Yu, E. M. Sparrow, E. R. G. Eckert, D. K. Hennecke, and N. Shamsundar Jan. 1972 42 p refs
(Contract N00014-68-A-0141-0001)
(AD-735492; HTL-105) Avail: NTIS CSCL 20/13

The heat transfer and fluid flow characteristics of a cylindrical enclosure having both rotating and stationary walls were investigated in the presence of coolant throughflow. The research was motivated by cooling applications in cavities and enclosures which may be situated adjacent to the rotating shaft in gas turbines, compressors, and similar devices. The local heat transfer coefficients on the rotating disk were found to increase with increasing rotational speed, increasing coolant flow rate, and decreasing spacing. Author (GRA)

**N72-21960#** Denver Research Inst., Colo.
**CONSTANT TOTAL PRESSURE EVAPORATION PROCESS WITH HEAT REUSE BY A BUILT-IN ENGINE**
Chen-yen Cheng, Hung-yean Sung, and Kyung Chang Kwon Sep. 1971 90 p refs
(Contract DI-14-01-001-2144)
(PB-204619; OSW-PR-703) Avail: NTIS; GPO HC $0.75 as 2400-0656 CSCL 07A

In a conventional evaporator, the pressure at the condensing side is maintained considerably higher than that at the boiling side in order to obtain the temperature differential required for heat transfer. A suitably selected auxiliary system consisting of two organic substances is incorporated within an evaporating system so that the heat released in the condensation step can be utilized in supplying the heat needed in the evaporating step under a constant total pressure condition. One of the two organic substances is called a boiling point depressor and is added to the boiling mass of the evaporator to lower its boiling temperature. The other organic substance is called an absorbent and is added on the condensing side to absorb the boiling point depressor vapor and raise the temperature of the condensing mass. Author (GRA)

**N72-21961#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**HEAT CONDUCTIVITY OF PLATES AND BODIES OF REVOLUTION**
I. A. Motovilovets 9 Feb. 1971 156 p refs Transl. into ENGLISH of the book "Teploprovodnost Plastin i Tel Vrashcheniya" Kiev, Idz-vo Naukora Dumka, 1969 p 1-44
(AF Proj. 4362)
(AD-735582; FTD-MT-24-275-70) Avail: NTIS CSCL 20/13

The book deals with stationary and nonstationary temperature fields forming plates, shells and bodies of revolution due to their heating by the environment. Given are numerous problems in the presence of mixed heating conditions and the investigation of thermoelastic stressed conditions of certain bodies. For solution of these problems, the author uses exact and approximation methods utilizing integral transformations. Author (GRA)

**N72-21962#** McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
**PLUME CONTAMINATION EFFECTS PREDICTION: THE CONTAM COMPUTER PROGRAM. PROGRAM USER'S MANUAL Final Report**
R. J. Hoffman, W. D. English, R. G. Oeding, and W. T. Webber Edwards AFB, Calif. AFRPL Dec. 1971 526 p refs
(Contract F04611-70-C-0076)
(AD-735722; MDC-G2529; AFRPL-TR-71-109) Avail: NTIS HC $6.00/MF $0.95 CSCL 22/2

The effect of rocket exhaust plume impingement on sensitive vehicle surfaces is an area of continuing concern in the design of spacecraft, missiles, and reentry vehicle systems. The objective of the study was to develop a single computer code capable of predicting the production, transport, and deposition of engine and plume contaminants, and the change in absorptivity, emissivity, reflectivity, and transmissivity of a functional spacecraft surface, such as thermal control coatings and optical view ports and lenses, resulting from plume contaminant deposition or mechanical abrasion (sand blasting). Analytical models and computer subprograms have been developed and integrated to form the CONTAM computer program. A sample case illustrating the CONTAM program's capability to predict contaminant production and transport is presented. Author (GRA)

**N72-21963#** Naval Air Engineering Center, Philadelphia, Pa. Engineering Dept.
**INVESTIGATIONS IN SUPPORT OF MK 7 JET BLAST DEFLECTOR COOLING MODULE DESIGN Final Report**
F. Slavin, W. Goon, and M. Siegel 17 Jan. 1972 309 p refs
(AD-735877; NAEC-ENG-7707) Avail: NTIS HC $6.00/MF $0.95 CSCL 13/1

The MK 7 Jet Blast Deflector was designed by the Naval Air Engineering Center to provide control of shipboard flight deck environment for operations with the FI 4 and other aircraft. The study describes the various design, experimental and analytical efforts undertaken to develop the cooling modules for the Jet Blast Deflector System. Analytical and experimental techniques were developed to deal with jet exhaust plume velocity-temperature contour maps in order to project the thermal conditions of the untested FI 4 case. Author (GRA)

**N72-21964#** California Univ., Los Angeles. Dept. of Physics.
**ATTENUATION OF THIRD SOUND IN LIQUID HELIUM AND THE STABILITY OF MULTIPLY QUANTIZED PERSISTENT CIRCULATIONS OF A THIN HELIUM FILM IN THE LANDAU REGION Ph.D. Thesis**
Taylor Gun-Jin Wang Oct. 1971 107 p refs
(Contract N00014-69-A-0200-4015; NR Proj. 384-302)
(AD-735924; TR-33) Avail: NTIS CSCL 20/13

The attenuation coefficiency has been measured by generating a third sound in a He II film coating a cylinder and observing the decay of pulses which propagate in both directions around the axis of the cylinder. Observed attenuations can be divided into three regions. The stability of multiply quantized persistent circulations was investigated by measuring the relative velocity of two third sound waves thermally generated from two parallel aluminum strips and detected by a superconductor strip midway between them. The author concludes that persistent currents with high quantum numbers are unstable in times of the order of that of the experiment, namely 1/60 sec. Author (GRA)

## 34 GENERAL

Includes information of a broad nature related to industrial applications and technology, and to basic research; defense aspects; information retrieval; management; law and related legal matters; and legislative hearings and documents.

**N72-21965** National Lending Library for Science and Technology, Boston Spa (England).
**THE THESAURUS IN INFORMATICS AND THEORETICAL SEMANTICS**
Yu. A. Shreider Jan. 1972 16 p refs Transl. into ENGLISH from Nauchn-Tekan. Inform., Ser. 2 (USSR), v. 3, 1971 p 21-24
(NLL-RTS-6886) Avail: Natl. Lending Library, Boston Spa, Engl.: £1.50; 5 NLL photocopy coupons

The use of a thesaurus for automatic language translation is considered. The thesaurus is defined as a set of meaning-reflecting elements (such as words and word combinations) in a particular language with given meaningful connotations. The structure of various approaches to the structure of the thesaurus are discussed. It is felt that the traditional view of semantics, laying primary stress on the study of the equivalence of meaning, applies a too rigid formal framework to semantic theory. N.E.N.

**N72-21966** National Lending Library for Science and Technology, Boston Spa (England).
**MAJOR DISCOVERIES BY SOVIET PHYSICISTS**
A. Presnyak [1971] 3 p Transl. into ENGLISH from the Russian report
(NLL-M-22112-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The recent discoveries of antihelium and excitons are announced. Antihelium 3 nuclei were registered on a 70 GeV accelerator, and more than 50,000 antideuterons were noted during the experiments. The existence of excitons was observed from a hydrogen-like absorption spectrum obtained when a very thin plate of copper monoxide crystal, cooled to liquid helium temperature, was exposed to light. N.E.N.

**N72-21967*#** McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
**INFORMATION MANAGEMENT SYSTEM STUDY RESULTS. VOLUME 2: IMS STUDY RESULTS APPENDIXES**
Nov. 1971 171 p refs
(Contract NAS8-25140)
(NASA-CR-121088; MDC-G2584-Vol-2-App) Avail: NTIS CSCL 05B

Computer systems program specifications are presented for the modular space station information management system. These are the computer program contract end item, data bus system, data bus breadboard, and display interface adapter specifications. The performance, design, tests, and qualification requirements are established for the implementation of the information management system. For Vol. 1, see N72-19972. N.E.N.

**N72-21968*#** Washington Univ., St. Louis, Mo.
**A GUIDE TO THE LITERATURE ON APPLICATION OF COMMUNICATIONS SATELLITES TO EDUCATIONAL DEVELOPMENT**
Robert P. Morgan and Jai P. Singh 1 Feb. 1972 41 p refs Prepared for Stanford Univ., Calif.
(Grant NGL-26-008-054)
(NASA-CR-125933) Avail: NTIS CSCL 05K

A review of literature dealing with communication satellite technology is presented for the nontechnical reader with emphasis on the educational aspects. An introduction is provided for: satellite technology; nontechnological aspects including economic, organizational, social, and political factors; and educational and developmental uses. A guide to selected literature, and a bibliography are included. F.O.S.

**N72-21969#** Waterloo Univ. (Ontario). Transport Group.
**A DOMESTIC MULTI-MODAL GOODS DISTRIBUTION MODEL WITH EMPHASIS ON AIR CARGO**
R. S. Wallace Feb. 1971 293 p refs Sponsored in part by NRC of CAN. and the Transport Dept., Ottawa
Avail: NTIS; Issuing Activity: $2.50

The transport role of air cargo is examined in conjunction with its two major competitors, road and rail over the period 1967 to 1987 for Canada. An understanding of these modes is provided by examining the historical development of each and the effect governmental regulations and policy decisions have had on their growth. A macro-demand model, forecasting the ton-mile freight demand for road, rail, and air services, is developed. A model, employing linear graph analysis, is developed to simulate the three mode transport industry. First the methodology and computer programs for the system are developed and demonstrated on a three node, two mode hypothetical system. A thirty city, three mode model of the nations goods distribution system is then calibrated on destination distribution using the collected base year data. Based on the macro forecast and projected cost trends air cargo is predicted to increase its share of the ton-mile market some sixteen times, from less than 0.05% in 1967 to 0.80% in 1987. Author

**N72-21970#** Waterloo Univ. (Ontario). Transport Group.
**SIMULATING THE TURNAROUND OPERATION OF PASSENGER AIRCRAFT USING THE CRITICAL PATH METHOD**
John P. Braaksma May 1971 175 p refs Sponsored in part by NRC of Can. and the Transport Dept., Ottawa
Avail: NTIS; Issuing Activity: $2.50

Ways to improve gate utilization at existing airports are studied by developing a simulation model of the turnaround operation. The model is based on the critical path method and consists of two components. The first is a network which represents the sequence and interrelationships of the turnaround activities. The second component is a set of parameters which transforms input data of a particular flight into activity durations. Numerical values for the parameters were obtained from an apron time survey conducted at Toronto International Airport. The aircraft types surveyed were DC 8L, DC 8, 707, 727L, 727, DC 9, and 737. Similarly the logic of the network was derived from observations on these aircraft made at the same airport. The output of the model predicts the turnaround time of a particular flight, identifies the critical path, and gives the spare time or float associated with the noncritical activities. The model was tested using two separate sets of data obtained from Toronto and it was demonstrated that it adequately represented the turnaround operations. Author

**N72-21971#** Waterloo Univ. (Ontario). Transport Group.
**NOTES FOR A SHORT COURSE ON PRACTICAL APPLICATIONS OF REGIONAL DEVELOPMENT MODELS**
O. Stradal (Swiss Federal Inst. of Tech., Zurich. Inst. for Natl., Regional and Local Planning) and B. G. Hutchinson Nov. 1971 147 p refs Sponsored in part by Can. Transport Comm.
Avail: NTIS; Issuing Activity: $3.00

A review of land use models for development of cities and regions is presented. Three levels of models are identified which are relevant to regional development planning, as follows: (1) macro models of regional development where the whole region is considered as a unit, (2) models of the allocation activities within a region where the development is observed relative to a set of individual zones, and (3) sector models, or one purpose models, such as transport and retail trade allocation models. Practical applications of equilibrium type models and selection of the best from a set of alternatives are discussed. Author

**N72-21972#** Waterloo Univ. (Ontario). Transport Group.
**A DESIGN METHOD FOR THE PREPARATION OF A PRELIMINARY URBAN LAND USE/TRANSPORT PLAN**
Richard W. Cockfield May 1970 196 p ref Sponsored in part by Central Mortgage and Housing Corp. of Ottawa, NRC of Can., Ind. Acceptance Corp. of Montreal
Avail: NTIS; Issuing Activity: $2.50

An original concept is developed from fundamentals and translated into a formulation for the purpose of deterministically synthesizing preliminary urban land use/transport plans. The urban entity is conceptualized as a system of human activities. Each activity requires a certain known amount of space and time

in order to be undertaken by an individual. The urban population supplies a known amount of structural space for the period of time that the activities are undertaken. The degree to which the structural space is utilized is the total sum of the difference between the product of the amount of structural space supplied and the amount of time it is supplied for an activity and the product of the amount of space required and the amount of time it is required. The objective is to maximize the utilization of the structural space by minimizing the number of structural spaces which must be supplied. This is achieved by forming the activities and their associated products of space and time required into the minimum number of subsets. When attempts are made to minimize the number of subjects in accordance with certain constraints of land use and transport a plan is produced.
Author

**N72-21973#** Advisory Group for Aerospace Research and Development, Paris (France).
**MEETINGS, PUBLICATIONS, MEMBERSHIP, JANUARY 1972**
Jan. 1972 65 p
(AGARD-Bull-72-1) Avail: NTIS

A calendar of technical meetings during 1972 is presented, and a summary of the theme of each meeting is included. Publications released in 1971 are listed, followed by their abstracts. Membership lists, effective as of 1 January 1972, are also given, and include the national delegates, national coordinators, panel members, Aerospace Applications Studies Committee, and headquarters personnel. N.E.N.

**N72-21974#** Institut d'Aeronomie Spatiale de Belgique, Brussels.
**BIBLIOGRAPHY, PART 9A. 1: TERRESTRIAL SPACE [BIBLIOGRAPHIE, FASCICULE 9A. 1: ESPACE TERRESTRE]**
1971 154 p refs
Avail: NTIS

The bibliography includes sections on meteorology, geomagnetism, aurora and airglow, and ionosphere. There are 823 entries. N.E.N.

**N72-21975#** Institut d'Aeronomie Spatiale de Belgique, Brussels.
**BIBLIOGRAPHY, PART 9B. 1: TERRESTRIAL SPACE [BIBLIOGRAPHIE, FASCICULE 9B. 1: ESPACE TERRESTRE]**
1971 118 p refs
Avail: NTIS

The bibliography includes sections on solar radiation, cosmic rays, satellite orbits, and structure of the upper atmosphere. There are 636 entries. N.E.N.

**N72-21976#** Centre de Recherches Scientifiques et Techniques de l'Industrie des Fabrications Metalliques, Brussels (Belgium).
**[ACTIVITIES OF THE CENTRE DE RECHERCHES SCIENTIFIQUES ET TECHNIQUES DE L'INDUSTRIE DES FABRICATIONS METALLIQUES] Annual Report, 1970**
1970 46 p In FRENCH
Avail: NTIS

Main activities of the Centre de Recherches Scientifiques et Techniques de l'Industrie des Fabrications Metalliques (CRIF), Belgium, are reported, including foundary work, mechanical engineering, metallurgy, and electrical engineering. ESRO

**N72-21977#** Transportation Systems Center, Cambridge, Mass.
**PERSONALIZED RAPID TRANSIT SYSTEMS: A FIRST ANALYSIS Final Report**
George Kovatch and George Zames 1 Aug. 1971 92 p refs
(PB-204801; DOT-TSC-OST-71-11) Avail: NTIS CSCL 13F

The analysis covers the significant advantages and disadvantages. Questions of system capacity, station capacity, urban grid design, and headway requirements are addressed. Current manufacturers' concepts are given with a functional classification of their major characteristics. Major component and system needs, which require further research and analysis, are described. A brief discussion of cost factors is also given.
Author (GRA)

**N72-21978#** Transportation Systems Center, Cambridge, Mass. Technical Information Center.
**REPORTS BIBLIOGRAPHY, OCTOBER 1971 Report for Jul. 1970 - Oct. 1971**
Albert L. Waters Oct. 1971 24 p refs
(PB-204803; DOT-TSC-OST-71-17) Avail: NTIS CSCL 05B

Reports are arranged in 22 subject fields and are listed by sponsoring agency name and address. Abstracts of each technical report are presented, cross referenced by COSATI field and subject title. GRA

**N72-21979#** Office of Naval Research, Arlington, Va.
**OPPORTUNITIES FOR NAVAL RESEARCH**
Jul. 1971 92 p
(AD-734183; ONR-17-Rev) Avail: NTIS CSCL 05/9

The document is a brief look at some topics that are of interest and concern to the Office of Naval Research presenting many areas which ONR considers important for the Navy and Marine Corps. There is a need for creative research-oriented scientists to take an interest in Navy problems and to propose investigations. Some of these may arise from suggestions found in this book; others may be new programs or approaches which can benefit the Navy. GRA

**N72-21980#** Army Foreign Science and Technology Center, Charlottesville, Va.
**ANTIAIRCRAFT DEFENSE HERALD**
3 Jan. 1972 132 p refs Transl. into ENGLISH from Vestn. Protivovozdushnoi Oborony (USSR), no. 6, Jun. 1971
(AD-735425; FSTC-HT-23-903-72; ACSI-K-0451) Avail: NTIS CSCL 15/3

Contents: Reliability and efficiency of radar information; A short exercise in tactics; Training with radar troop units; Teaching operators to locate and repair malfunctions; A scheme for the optimal processing of signals; Recording equipment parameters; The failure of Hitler's plan of aerial warfare upon the USSR; In defense of the cradle of the revolution. GRA

**N72-21981#** Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
**ON THE CORRECTNESS OF A PROBLEM WITH INITIAL CONDITIONS FOR A PARTIAL DIFFERENTIAL EQUATION**
G. V. Demidov 2 Apr. 1971 19 p refs Transl. into ENGLISH from Sibirsk. Mat. Zh. (USSR), v. 6, no. 5, 1965 p 985-996
(Contract N00017-72-C-4401)
(AD-735507; APL-CLB-3-T-639) Avail: NTIS CSCL 12/2

Considered is the correctness of the statement of an extremely simple problem for a model equation of meteorology used in the qualitative study of a number of aspects, particularly, the matching of the wind to the geostrophic. The uniqueness is proved by the energy integral method. The proof of the existence of the solution and of the continuous dependence on the initial data and the left side is given in the metric of functional spaces of S. L. Sobolev by means of Fourier transformation. Author (GRA)

**N72-21982#** Anagram Corp., Springfield, Va.
**SIMULATION FOR THE ASSESSMENT OF TACTICAL NUCLEAR WEAPONS (SATAN 2): OPERATIONAL CAPABILITY DESCRIPTION**
Marvin Lautzenheiser, William B. Bales, Nicholas H. Fletcher, and David A. Eoff 30 Nov. 1971 21 p
(Contract DCA100-70-C-0078)
(AD-735962; NMCSSC-SPM-OCD-66A-70) Avail: NTIS CSCL 15/6

The document describes the method by which SATAN 2

will be modified to include the added capabilities of: counter-battery operations, multi-fire and simultaneous fire at a target, intelligence, target doctrine improvements, increased damage assessment capabilities, data retrieval (Query), CalComp plots and an increased capability to create and/or destroy barriers. Author (GRA)

**N72-21983#** Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
**CONTROL CONSIDERATIONS FOR SHORT-HEADWAY ACGV SYSTEMS Final Report**
E. J. Hinman, R. B. McDowell, and R. A. Makofski Oct. 1971 321 p refs
(Contract DOT-UT-109)
(PB-205013; APL/JHU-TPR-018; UMTA-TRD-73-71-2) Avail: NTIS HC $6.00/MF $0.95 CSCL 13F

Command and control systems for automatically controlled and guided vehicle systems were investigated with emphasis on systems for short (up to 30 seconds) headway operation. Ten proposed systems which employ either conventional block control techniques or one or more large digital processors were evaluated. The conventional block approach and the central computer approach were used. Author (GRA)

**N72-21984#** California Univ., Los Angeles. School of Engineering and Applied Science.
**OPTIMIZATION OF A RESOURCE REUSE SYSTEM**
Cornelius T. Leondes and John Bohdan Marushar (N. Am. Rockwell Corp., Downey, Calif.) New York ASME 30 Jun. 1971 10 p refs Presented at ASME Winter Ann. Meeting, Washington, D. C., 28 Nov. - 2 Dec. 1971
(Grant AF-AFOSR-0699-67; AF Proj. 9749)
(AD-735223; AFOSR-72-0088TR; Rept-71-WA/Mgt-1) Avail: NTIS; ASME, United Eng. Center, 345 East 47th St., New York, N. Y. 10017 $3.00 CSCL 12/2

A model is formulated for a dynamic system characterized by the reuse of its resource after rehabilitation. A specific application is considered for a nation's mobilization effort. The criterion of performance is a functional of benefits, rehabilitation costs, and system expansion costs. The maximum principle is applied to determine the optimal control policy to change the capacity of the system. Author (GRA)

**N72-21985#** RAND Corp., Santa Monica, Calif.
**UNIFORMITY THEOREMS IN MISSILE DUELS**
Joel Spencer Sep. 1971 29 p ref
(Contract F44620-67-C-0045)
(AD-735260; R-844-PR) Avail: NTIS CSCL 15/3

A theorem dealing with the purchase of defensive weapon systems is proven. The purchaser's objective is assumed to be the achievement of an assumed destruction criterion at minimal cost. It is shown that under certain circumstances it is optimal to purchase a uniform defensive system. The applicability of the mathematical theorem to the real world is then studied. A second theorem gives a simple procedure for finding an attacker's optimal firing rule under very general circumstances. An example illustrates the problems in choosing a defensive weapon system. Author (GRA)

**N72-21986#** Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
**RESEARCH AND DEVELOPMENT PROGRAMS Quarterly Progress Report, 1 Jan. - 31 Mar. 1971**
N. Rubinstein, R. E. Walker, J. C. Pirkle, R. K. Frazer, and N. Rubinstein 31 Mar. 1971 40 p refs
(Contract N00017-62-C-0604)
(AD-735869; APL-U-RQR/71-1) Avail: NTIS CSCL 05/2

Results are reported on work in the following categories: Microelectronics Laboratory status and improvements; fast flow chemical laser experiment; chemical laser systems, analysis; limitations of current radomes; vibration studies; calorimeter and transpiration cooling free-jet tests; digital control of a missile seeker head; airbreathing propulsion studies which include supersonic combustion analysis and flowfield determination for engine testing; a wideband array antenna system; Scram jet propulsion research; meteorological applications of a bidirectional thermistor mass flow sensor; activities of the Environmental Test Laboratory; and energy storage in fiber-composite bar blywheels. Author (GRA)

**N72-21987#** Office of Naval Research, London (England).
**EUROPEAN SCIENTIFIC NOTES, VOLUME 25, NUMBER 12**
John G. Foss 31 Dec. 1971 42 p refs
(AD-735897) Avail: NTIS CSCL 14/2

The report is a monthly publication presenting brief articles concerning recent developments in European scientific research. It is hoped that these articles (which do not constitute part of the scientific literature) may prove of value to American scientists by disclosing interesting information well in advance of the usual scientific publications. Author (GRA)

**N72-21988#** Army Weapons Command, Rock Island, Ill. Cost Analysis Office.
**COST ESTIMATING RELATIONSHIPS FOR AIRCRAFT ARMAMENT SUBSYSTEM MANUFACTURING LABOR COST**
Patrick J. Gannon Sep. 1971 38 p refs
(AD-735495; AMSWE-CPE-71-11) Avail: NTIS CSCL 19/6

Cost estimating relationships for pintle, side mounted and turret aircraft armament subsystems are described in sufficient detail to allow someone to estimate direct labor plus quality control labor costs given subsystem weight and quantity to be procurred. Author (GRA)

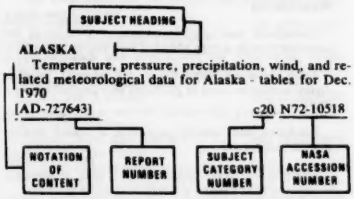
**N72-21989#** Coast Guard, Washington, D.C. Operations Plans Staff.
**THE SAR CRITERIA AND FORCE ANALYSIS Final Report**
T. T. Matteson and R. R. Wells 8 Nov. 1971 53 p refs
(AD-735408) Avail: NTIS CSCL 06/7

The report is the final report of the SAR Criteria and Force Analysis Study. This multi-year effort has given form and substance to the SAR decision making process. The study has developed and delivered several decision making aids to the program manager so that he can now examine, on an integrated basis (i.e., aircraft, cutters, and shore stations), the probable outcome of alternative search and rescue resource allocations. Intrinsic to such examinations are: (1) refined projections of future demand, (2) consideration of alternative manning, readiness and maintenance policies, and (3) comparison of results with cost and effectiveness criteria synthesized by the program manager. Author (GRA)

**N72-21990#** American Inst. of Physics, New York. Physics Information Div.
**AN ANALYSIS OF THE REVIEW LITERATURE IN PHYSICS**
Janice Stern 1971 6 p refs Repr. from Proc. of the ASIS Ann. Meeting, v. 8, 1971 p 91-96
(PB-204859; ID-71D) Avail: NTIS CSCL 05B

The existing review literature in physics was studied in order to gain insight towards stimulating further development of this retrieval key. Four investigations, focusing in turn on the responses of three groups (editors, authors and users) were conducted dealing with the generation, publication, and dissemination of reviews. The results include the identification of present publication outlets; an examination of current editorial policies; analysis of motivation, methods used and time spent by authors to complete a review project; and analysis of the evaluation made by readers of a critical review. Author (GRA)

## TYPICAL SUBJECT INDEX LISTING

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## A

**A-37 AIRCRAFT**
Development of techniques and equipment for determining moment of inertia of aircraft as applied to A-37 and P-1127 aircraft
[FTC-TIM-71-1001] c02 N72-21007

**ABLATION**
Development of sensors for detecting amount of ablation over ablating surfaces and change in boundary layer flow conditions
[NASA-CASE-LAR-10439-1] c33 N72-21956

**ABLATIVE MATERIALS**
Effects of fabrication-induced defects on performance of ablative heat shield materials in simulated space shuttle reentry
[NASA-CR-2010] c33 N72-21954
Development of sensors for detecting amount of ablation over ablating surfaces and change in boundary layer flow conditions
[NASA-CASE-LAR-10439-1] c33 N72-21956

**ABSORBENTS**
Boiling point depressor and absorbent in constant total pressure evaporation process with heat reuse by built-in engine
[PB-204619] c33 N72-21960

**ABSORPTION SPECTRA**
Spatial correlation of auroral radio absorption, using riometers
c07 N72-21146
Absorption spectra of atmospheric gases in vacuum ultraviolet regions
[NLL-M-22123-[5828.4F]] c13 N72-21352
Measurement of absorption structure of lithium, beryllium, sodium, magnesium, and aluminum by photoabsorption process
c26 N72-21735
Soft X ray spectroscopic method for recording L series valence band spectra in iron, cobalt, nickel, copper, and zinc
[NASA-CR-126042] c26 N72-21742

**ABSORPTION SPECTROSCOPY**
Effects of high pressure on spectroscopic properties of aromatic hydrocarbons
[AD-735163] c06 N72-21116
Study of adsorption kinetics in liquid phase using atomic absorption spectrophotometry
[NASA-TT-F-14263] c14 N72-21425
Colloidal metallic dispersions and atomic absorption spectrometry
[NASA-TT-F-14232] c17 N72-21536

**ABSORPTIVITY**
Determination of atmospheric absorption coefficient in shortwave region of decimeter range
[NLL-M-22050-[5828.4F]] c13 N72-21349

**ABSTRACTS**
Abstracts on space biology and medicine involved in cosmonaut training
[JPRS-55687] c04 N72-21043
Medical research abstracts on limulus visual system, electronic neuron model development, and auditory adaptation in horseshoe crab
[AD-734017] c04 N72-21073
Abstracts, bibliographies, and index on Soviet cybernetics
[AD-735651] c10 N72-21278

**ACCELERATION (PHYSICS)**
Grid accelerator system for ion thrustor
[NASA-CASE-XLE-10453-2] c28 N72-21821

**ACCELEROMETERS**
Determination of platform fluctuation in inertial navigation system due to dry friction in accelerometer
[AD-734920] c21 N72-21643

**ACOUSTIC IMPEDANCE**
Sound transmission impedance in cyclindrical steel shells
[NLL-M-22125-[5828.4F]] c23 N72-21660

**ACOUSTIC MEASUREMENTS**
Environmental tests of hydrophones to obtain acceleration response measurements
[AD-735931] c13 N72-21391
Acoustic emission technique for determining crack growth rate in high strength cantilever steel type specimens
c14 N72-21917

**ACOUSTIC PROPAGATION**
Models for sound propagation and reverberation, surface backscattering coefficients, and sonar performance prediction
[AD-735995] c13 N72-21390

**ACOUSTIC PROPERTIES**
Multichannel pneumoacoustic control system for open drive
[AD-735234] c15 N72-21495

**ACOUSTO-OPTICS**
Acousto-optic interactions and size limiting factors in color center memory systems
[AD-735903] c08 N72-21240

**ACTUATORS**
Mechanically operated hand which can depress trigger using touch control device
[NASA-CASE-MFS-20413] c15 N72-21463
Rotary actuator for use in high vacuum celestial space environments
[NASA-CASE-NPO-10244] c15 N72-21478

**ADAPTIVE CONTROL**
Computer system using adaptive voting to tolerate failure and operate in fail-operational, fail-safe manner
[NASA-CASE-MSC-13932-1] c08 N72-21206
On-line adaptive controller for drawing and coating of glass rods for resistors
[AD-735154] c15 N72-21500
Quadratic Liapunov functions for vector differential equations in adaptive control system models
[AD-735482] c19 N72-21573
Design of adaptive control systems using Liapunov method
[AD-735481] c19 N72-21574
Automatic vehicle control using navigation and guidance algorithms based on digital statistical data
[AD-735605] c21 N72-21637
Adaptive control autopilot for identifying tactical missile
[AD-735488] c31 N72-21899

**ADHESION**
Processes, surfacer reactions, and mixing theory of adhesion
[NLL-RTS-6925] c06 N72-21093

**ADSORPTION**
Study of adsorption kinetics in liquid phase using atomic absorption spectrophotometry
[NASA-TT-F-14263] c14 N72-21425
Rhenium adsorption in activated carbons
[NASA-TT-F-14250] c17 N72-21535
Infrared spectroscopic examination of adsorption on clean metal surface produced by interaction of gases under high vacuum
[NLL-RTS-6710] c26 N72-21699

**AERIAL EXPLOSIONS**
Effects of exposure to blast induced winds and pressure variations on biophysical parameters
[AD-734208] c04 N72-21054

**AERIAL PHOTOGRAPHY**
Application of aerial photographic interpretation in field and office geomorphological research
[NASA-TT-F-624] c13 N72-21364
Automatic data reduction aerial photographs of highway traffic
[PB-204810] c14 N72-21450
Application of aerial photography for detecting effects of air pollution from sulfur dioxide on stands of timber
[PB-205279] c14 N72-21458

**AERIAL RECONNAISSANCE**
Design, development, and characteristics of remote sensing systems and display devices for aerial reconnaissance and radar imagery
[AD-735752] c07 N72-21188
Application of infrared sensing techniques to water exploration
[NASA-CR-126025] c13 N72-21357
Experimental aerial gravimetry program to determine feasibility of large scale aerial gravity surveys
[AD-735266] c13 N72-21394

**AERIAL RUDDERS**
Development of direct side force control on aircraft during flight and application to improved bombing accuracy
[AD-735294] c02 N72-21030

**AERODYNAMIC BALANCE**
Wind tunnel balance system for determining wind-induced vibrations in space shuttle model
[NASA-CR-115531] c11 N72-21288

**AERODYNAMIC BRAKES**
Development and characteristics of parachute fabric for aerodynamic decelerator using lightweight, variable solidity, knitted material
[NASA-CASE-LAR-10776-1] c02 N72-21004

**AERODYNAMIC CHARACTERISTICS**
Aerodynamic characteristics of low aspect ratio, cruciform wing missile model with all-moveable wings and tails at supersonic speed
[NASA-TM-X-2531] c01 N72-20971
Vortex ring method used for calculations of aerodynamic characteristics of helicopter lifting rotors at any angle of attack in flow with comparatively high velocity
[AD-735439] c01 N72-20973
Flight test procedures for determining stall and spin characteristics of high performance aircraft
c02 N72-20979
Development of flight test procedures for use with advanced aircraft to determine cruise performance characteristics
c02 N72-20985
Techniques and procedures for conducting flight tests of lifting body type aircraft during transonic and supersonic flight conditions
[NASA-TM-X-68306] c02 N72-20986
Determination of performance data and stability and control characteristics from aircraft performance under nonsteady flight conditions
c02 N72-20992
Wind tunnel tests of M2-F2 lifting body entry configuration at transonic and supersonic speeds and selected Reynolds numbers
[NASA-TM-X-2511] c02 N72-21005
Blade stress analysis, wind tunnel models, and test procedures for investigating conversion process of folding tilt-rotor aircraft - Vol. 4
[AD-735733] c02 N72-21028
Evaluation of static-pressure measuring probes used in wind tunnel tests at supersonic and hypersonic speeds
[AD-736017] c14 N72-21461
Characteristics of aircraft using supercritical aerodynamics and analysis of turbofan engine performance with single and double stage configurations
[NASA-TM-X-68031] c28 N72-21816
Longitudinal and lateral aerodynamic characteristics of scale model of GD/C aerospace shuttle booster in wind tunnel force tests
[NASA-CR-119992] c31 N72-21886
Low speed aerodynamic characteristics of GD/C B-18E3 space shuttle booster
[NASA-CR-120035] c31 N72-21888

**AERODYNAMIC COEFFICIENTS**
Lifting airfoils with supercritical shock-free flow
[NLR-MP-70015-U] c01 N72-20972

Comparison of flight test and wind tunnel data to determine areas of agreement when nonlinearities appear in aerodynamic coefficients of slender wing aircraft
c02 N72-20990
Development of numerical process for extracting aerodynamic coefficients from flight test data
c19 N72-20991

AERODYNAMIC HEATING
Determination of effects of shock heating of radome on radar range of ground station
c07 N72-21158

AERODYNAMIC LOADS
Application of statistical methods for establishing positive maneuver loads design criteria for fighter aircraft
[AD-735472] c02 N72-21015

AERODYNAMIC NOISE
Aircraft noise reduction by extinction with reversed phase sound in acoustic interference
[MBB-BB-55-71-O] c02 N72-21011

AERODYNAMIC STABILITY
Aerodynamic wind tunnel stability tests for determining fin deflection angle and vertical position of frustrum of space shuttle at high angles of attack
[NASA-CR-120040] c31 N72-21889

AERODYNAMIC STALLING
Flight test procedures for determining stall and spin characteristics of high performance aircraft
c02 N72-20979

AERODYNAMICS
Problems in aerodynamics of sustained hypersonic flight
[NASA-TT-F-14235] c02 N72-21006

AERONAUTICAL ENGINEERING
Development of Soviet aviation from prerevolution to 1970
[AD-735204] c02 N72-21019

AEROS SATELLITE
Electrically conducting solar cell doped metal oxide transparent coating for Aeros satellite equipotential surface
c18 N72-21558

AEROSOLS
Liquid aerosol dispenser with explosively driven piston to compress light gas to extremely high pressure
[NASA-CASE-MFS-20829] c12 N72-21310
Radiation measurements for determination of atmospheric dust particle concentration
[ISL-6/71] c13 N72-21373

AEROSPACE ENVIRONMENTS
Safe pressurized lighting system for operating in hazardous environments
[NASA-CASE-KSC-10644-1] c09 N72-21250
Rotary actuator for use in high vacuum celestial space environments
[NASA-CASE-NPO-10244] c15 N72-21478
Measurement of solar absorption and thermal emittance properties of selected thermal control coatings exposed to exhaust of thruster engine
[NASA-TM-X-68044] c33 N72-21952

AEROSPACE INDUSTRY
Flight programming languages for aerospace applications
[NASA-CR-123569] c08 N72-21201
Announcing aerospace developments in seals and sealing techniques for technology utilization in other industries
[NASA-SP-5905[03]] c15 N72-21480

AEROSPACE MEDICINE
Abstracts on space biology and medicine involved in cosmonaut training
[JPRS-55687] c04 N72-21043

AEROSPACE SYSTEMS
Application of digital computer techniques to aerospace systems and impact of new technologies
c08 N72-21212
Advantages and disadvantages of federated and integrated computer system organizations for utilization in current aerospace systems
c08 N72-21213

AEROSPACE VEHICLES
Software and hardware technology for application of computer systems to guidance and control of aerospace vehicles
[AGARDOGRAPH-158] c08 N72-21211
Generation and checkout of computer programs for real time control of aerospace vehicles
c08 N72-21215

AGING [MATERIALS]
Creep strength reduction in strain-aging refractory alloys by applying low-amplitude, high-frequency fatigue vibrations during creep tests
[NASA-CR-120891] c17 N72-21529

AGRICULTURE
Classification modes for multidisciplinary, high data rate requirements of ERTS satellites
[NASA-CR-126024] c13 N72-21358

AIR BREATHING ENGINES
Development of techniques for evaluating performance of air breathing engines and measurement of significant operating parameters
[NASA-TM-X-68305] c28 N72-20983

AIR CONDITIONING
Ventilation systems for 33-foot diameter space station and 14-foot diameter modular space station
[NASA-CR-123593] c31 N72-21879

AIR NAVIGATION
Analysis of tasks required for data processing equipment in advanced aircraft navigation systems
c21 N72-21222
Development of system for position location reporting and control of tactical aircraft using recursive navigation program
[AD-735262] c21 N72-21636

AIR POLLUTION
Assessment of aircraft emission control technology and feasibility analysis of various control methods
[PB-204878] c02 N72-21017
Exhaust emissions tests of aircraft propulsion and auxiliary power gas turbine engines
[PB-204920] c02 N72-21018
Sulfur dioxide vs. particulate matter damage to electronic equipment from air pollution
[PB-204183] c09 N72-21259
Holographic recording of limestone pollution by back or side scattering of ruby laser beam
[PB-205189] c14 N72-21457
Application of aerial photography for detecting effects of air pollution from sulfur dioxide on stands of timber
[PB-205279] c14 N72-21458
International survey of air pollution by aircraft engines and fuels
[AGARD-AR-40] c20 N72-21590
Instruments for measuring air pollution emmitted by aircraft engines
[PB-204794] c20 N72-21592
Effects of atmospheric odorous exposure on community health and annoyance reactions
[PB-204989] c20 N72-21598

AIR TRAFFIC CONTROL
Motion picture test for air traffic control aptitude for use in personnel selection and evaluation
[AD-735942] c05 N72-21085
Data base security and access limitation requirements for post 1975 automated TACC complex with tabulated security data
[AD-735729] c08 N72-21235
Bibliography of reports and simulation models describing air traffic control procedures for all phases of aircraft operation
[DOT-TSC-FAA-71-7] c21 N72-21626
Development and characteristics of microwave scanning beam approach and landing system phased array antenna
[DOT-TSC-FAA-71-29] c21 N72-21627
Development of discrete address beacon system to improve operation of microwave landing system for high density terminal area surveillance
[DOT-TSC-FAA-71-26] c21 N72-21628
Air traffic control analysis of North Atlantic commercial aircraft operation based on inertial navigation and satellite surveillance
[DOT-TSC-FAA-71-13] c21 N72-21629
Evaluation of FAA advanced flow control procedures for air traffic control based on digital simulation of New York City air traffic
[DOT-TSC-FAA-72-8] c21 N72-21630
Development of model of airport airside system to simulate aircraft operations and controller functions in terminal area
[PB-204802] c21 N72-21634
Planning and management of air traffic control system based on random sample of flight plans filed at flight service stations during calendar year 1970
[AD-735970] c21 N72-21641
Analysis of air traffic control procedures employed on air routes over North Atlantic Ocean
[PB-204862] c21 N72-21642

AIR TRANSPORTATION
Evaluation of FAA advanced flow control procedures for air traffic control based on digital simulation of New York City air traffic
[DOT-TSC-FAA-72-8] c21 N72-21630
Role of air cargo in Canadian transportation for period 1967 to 1987
c34 N72-21969

AIR WATER INTERACTIONS
Spectral characteristics of wind driven waves over small areas of water
[RAE-LIB-TRANS-1634] c13 N72-21363

AIRBORNE/SPACEBORNE COMPUTERS
Software and hardware technology for application of computer systems to guidance and control of aerospace vehicles
[AGARDOGRAPH-158] c08 N72-21211
Application of digital computer techniques to aerospace systems and impact of new technologies
c08 N72-21212
Advantages and disadvantages of federated and integrated computer system organizations for utilization in current aerospace systems
c08 N72-21213
Hardware organization and system design of guidance and control computers
c08 N72-21214
Generation and checkout of computer programs for real time control of aerospace vehicles
c08 N72-21215
Programming characteristics of future guidance and control computers
c08 N72-21216
Data word length considerations for aerospace computer implementation to obtain required precision levels
c08 N72-21217
Aerospace computer memory technology and application of particular techniques to various system requirements
c08 N72-21218
Aerospace computer input-output techniques for consideration in design phase of interfacing equipment
c08 N72-21219
Fault isolation capabilities for general purpose digital computer used in guidance and control applications
c08 N72-21220
Guidance and control computer actuated display system techniques
c08 N72-21221
Analysis of tasks required for data processing equipment in advanced aircraft navigation systems
c21 N72-21222
Central digital computers for helicopter guidance and control systems
c08 N72-21223
Navigation/guidance computer requirements for integrated navigation system using combination of outputs of inertial, Doppler, and loran equipment
c08 N72-21224
Application of airborne digital computers to loran C/D and Omega navigation and guidance systems
c08 N72-21225
Selection of computers for satellite based navigation and guidance system designed for aircraft users
c08 N72-21226
Digital computers for navigation and guidance systems and fire control systems in tactical aircraft
c08 N72-21227
Data acquisition and transmission methods in relation to ESRO satellites, with emphasis on onboard computers
c07 N72-21295

AIRCRAFT ACCIDENT INVESTIGATION
Report of aircraft accident involving Beechcraft 99 air taxi at Allentown, Pennsylvania on 24 October, 1971
[NTSB-AAR-72-3] c02 N72-21002
Investigation of fire aboard Vickers Viscount aircraft following landing at Honolulu, Hawaii on 8 August, 1971
[NTSB-AAR-72-2] c02 N72-21003
Relative incidence and cost data for orientation-error accidents in regular Army UH-1 aircraft during fiscal year 1968
[AD-735457] c02 N72-21016
Aircraft accident report of DC 9 crash landing at Standiford Field, Louisville, Kentucky on 8 Sept. 1970
[PB-205250] c02 N72-21020
Briefs of US general aviation aircraft accidents involving missing aircraft and missing aircraft later recovered during 1969
[PB-205097] c02 N72-21021
Briefs of US general aviation aircraft accidents involving air taxi operations during 1969
[PB-205096] c02 N72-21022
Briefs of US general aviation accidents involving aerial application operations during 1969
[PB-204811] c02 N72-21025

AIRCRAFT ACCIDENTS
Compilation of US general aviation accidents for 1969 in which impairment of judgement and efficiency by alcohol was involved
[PB-204991] c02 N72-21023
Compilation of accidents involving helicopters and rotor craft for United States general aviation operations during 1969
[PB-204812] c02 N72-21024
Compilation of United States general aviation accidents involving weather as cause or cause related factor year 1969
[PB-204926] c02 N72-21026
Use of shoulder harness in general aviation aircraft to prevent or minimize injury during crashes
[FAA-AM-72-3] c05 N72-21077
Effectiveness of restraint equipment in controlling head impact forces and body kinematics in enclosed aircraft areas
[FAA-AM-72-6] c05 N72-21078
Battery powered aircraft crash locator transmitter
[NASA-CASE-MFS-16609] c14 N72-21431

AIRCRAFT ANTENNAS
Characteristics of ultrahigh frequency and very high frequency aircraft antennas for aircraft-satellite communications link
[PB-204799] c07 N72-21165
Numerical-analytical techniques for predicting radiation patterns and impedance of aircraft antennas including effects of outboard members of aircraft structure
[AD-735346] c07 N72-21171

Requirements for high frequency aircraft antennas
[AD-735886] c07 N72-21176
**AIRCRAFT APPROACH SPACING**
Economical satellite aided vehicle avoidance system for preventing midair collisions
[NASA-CASE-ERC-10419] c21 N72-21631
**AIRCRAFT CARRIERS**
Flight tests to determine suitability of aircraft for operation on aircraft carriers
c02 N72-20988
Jet blast deflector for controlling shipboard flight deck environment
[AD-735877] c33 N72-21963
**AIRCRAFT CONFIGURATIONS**
Techniques and procedures for conducting flight tests of lifting body type aircraft during transonic and supersonic flight conditions
[NASA-TM-X-68306] c02 N72-20986
Dual fuselage aircraft design with yawable wing and horizontal stabilizer
[NASA-CASE-ARC-10470-1] c02 N72-21010
**AIRCRAFT CONTROL**
Aerodynamic control system for controlling flutter
[NASA-CASE-LAR-10682-1] c02 N72-21009
Development of direct side force control on aircraft during flight and application to improved bombing accuracy
[AD-735294] c02 N72-21030
Terminal guidance system for guiding aircraft into preselected altitude and/or heading at terminal point
[NASA-CASE-FRC-10049-1] c21 N72-21632
**AIRCRAFT DESIGN**
Dual fuselage aircraft design with yawable wing and horizontal stabilizer
[NASA-CASE-ARC-10470-1] c02 N72-21010
Application of statistical methods for establishing positive maneuver loads design criteria for fighter aircraft
[AD-735472] c02 N72-21015
Characteristics of aircraft using supercritical aerodynamics and analysis of turbofan engine performance with single and double stage configurations
[NASA-TM-X-68031] c28 N72-21816
**AIRCRAFT ENGINES**
Assessment of aircraft emission control technology and feasibility analysis of various control methods
[PB-204878] c02 N72-21017
Exhaust emissions tests of aircraft propulsion and auxiliary power gas turbine engines
[PB-204920] c02 N72-21018
International survey of air pollution by aircraft engines and fuels
[AGARD-AR-40] c20 N72-21590
Instruments for measuring air pollution emmitted by aircraft engines
[PB-204794] c20 N72-21592
**AIRCRAFT EQUIPMENT**
Pilot warning indicator system
[NASA-CASE-ERC-10226-2] c02 N72-21008
Battery powered aircraft crash locator transmitter
[NASA-CASE-MFS-16609] c14 N72-21431
Application of thermistor mass flow rate sensor to aircraft meteorological instruments
[AD-736152] c20 N72-21622
Design and development of collision avoidance system for use with general aviation aircraft
[NASA-CR-112023] c21 N72-21625
Cost estimates for pintle, side mounted, and turret armament subsystems
[AD-735495] c34 N72-21988
**AIRCRAFT FUELS**
International survey of air pollution by aircraft engines and fuels
[AGARD-AR-40] c20 N72-21590
**AIRCRAFT GUIDANCE**
Software and hardware technology for application of computer systems to guidance and control of aerospace vehicles
[AGARDOGRAPH-158] c08 N72-21211
Hardware organization and system design of guidance and control computers
c08 N72-21214
Programming characteristics of future guidance and control computers
c08 N72-21216
Fault isolation capabilities for general purpose digital computer used in guidance and control applications
c08 N72-21220
Guidance and control computer actuated display system techniques
c08 N72-21221
Central digital computers for helicopter guidance and control systems
c08 N72-21223
Application of airborne digital computers to loran C/D and Omega navigation and guidance systems
c08 N72-21225
Selection of computers for satellite based navigation and guidance system designed for aircraft users
c08 N72-21226
Digital computers for navigation and guidance systems and fire control systems in tactical aircraft
c08 N72-21227
**AIRCRAFT HAZARDS**
Development of active and passive techniques for detecting and measuring presence and intensity of wingtip vortices generated in airport areas
[DOT-TSC-FAA-72-13] c02 N72-20999
Compilation of United States general aviation accidents involving weather as cause or cause related factor year 1969
[PB-204926] c02 N72-21026
**AIRCRAFT LANDING**
Techniques for measuring and monitoring slant visibility of pilots landing aircraft in fog and haze
[DOT-TSC-FAA-71-25] c02 N72-20998
Report of aircraft accident involving Beechcraft 99 air taxi at Allentown, Pennsylvania on 24 October, 1971
[NTSB-AAR-72-3] c02 N72-21002
**AIRCRAFT NOISE**
Numerical analysis of aircraft noise created by externally blown flaps on STOL aircraft and methods for noise reduction
[NASA-TM-X-68047] c02 N72-21001
**AIRCRAFT PERFORMANCE**
Proceedings of conference on aircraft flight test procedures, data acquisition, data processing, and correlation with wind tunnel test results
[AGARD-CP-85] c02 N72-20976
Flight test program and data acquisition techniques for evaluation of Boeing 747 aircraft
c02 N72-20977
Mathematical models for determining flight performance of Concorde aircraft
c02 N72-20978
Flight tests of VTOL aircraft DO 31
c02 N72-20981
Methods and instruments for determining performance of Concorde aircraft
c02 N72-20982
Development of flight test procedures for use with advanced aircraft to determine cruise performance characteristics
c02 N72-20985
Flight tests performed following initial delivery or extensive repair and overhaul as performed by Canadian Armed Forces
c02 N72-20987
Flight tests to determine suitability of aircraft for operation on aircraft carriers
c02 N72-20988
Flight test procedures for determining turning capability of military aircraft
c02 N72-20989
Determination of performance data and stability and control characteristics from aircraft performance under nonsteady flight conditions
c02 N72-20992
Application of statistical methods for establishing positive maneuver loads design criteria for fighter aircraft
[AD-735472] c02 N72-21015
**AIRCRAFT SAFETY**
Computer program and numerical analysis of feasibility of using suction between and along runways to remove trailing edge vortex streets
[IDA-LOG-HQ-69-10164] c11 N72-21290
Development of discrete address beacon system to improve operation of microwave landing system for high density terminal area surveillance
[DOT-TSC-FAA-71-26] c21 N72-21628
**AIRCRAFT STABILITY**
Proceedings of conference on aircraft flight test procedures, data acquisition, data processing, and correlation with wind tunnel test results
[AGARD-CP-85] c02 N72-20976
Flight test procedures for determining stall and spin characteristics of high performance aircraft
c02 N72-20979
Stability and control flight test procedures for V/STOL aircraft in general and specific application to P-1127 and Harrier aircraft
c02 N72-20980
**AIRCRAFT STRUCTURES**
Mutual aerodynamic interference effects on flow field beneath aircraft with external stores examined by cross flow corrections method
[AD-735655] c01 N72-20974
Stress corrosion cracking in aircraft structures and various materials - historical review
c32 N72-21901
**AIRFOIL PROFILES**
Lifting airfoils with supercritical shock-free flow
[NLR-MP-70015-U] c01 N72-20972
**AIRFRAMES**
Numerical-analytical techniques for predicting radiation patterns and impedance of aircraft antennas including effects of outboard members of aircraft structure
[AD-735346] c07 N72-21171
**AIRGLOW**
Proceedings of institute for aurora and airglow investigations during 1970
[AD-735151] c13 N72-21384
Meteorology, geomagnetism, auroras, airglow, and ionosphere - bibliography
c34 N72-21974
**AIRLINE OPERATIONS**
Numerical analysis of aircraft collision probability due to reduced separation intervals and arbitrary flight paths
[DOT-TSC-FAA-71-27] c02 N72-20997
Analysis of information flow requirements between control tower operators and aircraft pilots and methods for displaying information
[DOT-TSC-FAA-71-18] c02 N72-21000
Investigation of fire aboard Vickers Viscount aircraft following landing at Honolulu, Hawaii on 8 August, 1971
[NTSB-AAR-72-2] c02 N72-21003
Air traffic control analysis of North Atlantic commercial aircraft operation based on inertial navigation and satellite surveillance
[DOT-TSC-FAA-71-13] c21 N72-21629
Simulation of turnaround operation of passenger aircraft using critical path method for improving aircraft/terminal utilization
c34 N72-21970
**AIRPORT BEACONS**
Development of discrete address beacon system to improve operation of microwave landing system for high density terminal area surveillance
[DOT-TSC-FAA-71-26] c21 N72-21628
**AIRPORT TOWERS**
Analysis of information flow requirements between control tower operators and aircraft pilots and methods for displaying information
[DOT-TSC-FAA-71-18] c02 N72-21000
**ALCOHOLS**
Compilation of US general aviation accidents for 1969 in which impairment of judgement and efficiency by alcohol was involved
[PB-204991] c02 N72-21023
**ALGORITHMS**
Digital signal processing algorithms useful in speech research
[AD-735921] c07 N72-21185
Two computer algorithms for obtaining periodic response of nonlinear circuits
[AD-735713] c08 N72-21232
Algorithm for approximate solution of vector Toeplitz systems
[UCRL-73495] c19 N72-21571
Method of multipliers for constrained minimization in relation to ordinary and conjugate gradient algorithms
[PB-205311] c19 N72-21575
**ALIGNMENT**
Apparatus for aligning shadow shields and cryogenic storage tanks in outer space with the sun
[NASA-CASE-KSC-10622-1] c31 N72-21893
**ALKALI METALS**
Interpretation of absolute Knight shifts of alkalis, variations with pressure, and absolute Knight shifts in binary alkali systems
c26 N72-21778
**ALKALINE EARTH METALS**
Effects of compression on band structure and density of states of alkaline metals by augmented plane wave method
c26 N72-21712
**ALLOYS**
Superplastic alloys and metals
[NLL-RTS-6944] c17 N72-21515
Catalog of reports on metallurgy subjects for period 1965 through 1971
[AD-735150] c17 N72-21551
Atomic Structure of disordered alloys
c26 N72-21758
Pauli paramagnetic susceptibility in metals and alloys with high electron density of state
c26 N72-21777
Effects of repassivation and crack velocity on stress corrosion cracking in alloys
c17 N72-21907
Mechanical properties and stress corrosion of hot rolled alloy plates
c32 N72-21931
**ALPHA PARTICLES**
Analysis of solar flare particle measurements by Explorer 34 and 41 satellites
[NASA-CR-122389] c29 N72-21831
Penetration of low energy solar protons and alpha particles in interplanetary space and magnetosphere to magnetic equator
c29 N72-21833
Temporal and spectral changes in access of solar protons and alpha particles to synchronous altitude inside magnetosphere
c29 N72-21836
Low energy solar protons and alpha particles detected during 1967 solar flare used to probe properties of interplanetary space
c29 N72-21838
Low energy solar alpha to solar proton flux ratios observed following three solar flares of May 23, 1967
c29 N72-21840
Semiconductor particle telescope measurements of electron, proton, and alpha particle fluxes produced by Nov. 1969 west limb flare
c29 N72-21841

Explorer 34 measurements of low energy protons and alpha particles emitted during east limb solar flares
c29 N72-21842

Explorer 34 measurements of interplanetary solar protons and alpha particles during Oct. 26 through Nov. 1, 1968
c29 N72-21843

Explorer 34 measurements of solar protons, electrons, and alpha particles during extreme west hemisphere 1B solar flare of Nov. 18, 1968
c29 N72-21844

Ground and spacecraft observations of flare protons, alpha particles, and electrons
c29 N72-21848

**ALUMINUM**

Using two-dimensional Lagrangian code to computer growth of perturbed interface between perfect gas and aluminum
[LA-4754] c12 N72-21319

Using Ashcroft energy band model representation of measured Fermi surface for calculating optical properties of aluminum
c17 N72-21706

Interpreting photoemission data from indium and aluminum in terms of density of states models
c26 N72-21721

Correlation of changes in Knight shift and soft X ray emission edge height of aluminum in Al metal, alloys, and oxide
c26 N72-21780

Statistical errors in estimating density of states curves from energy band calculations, using aluminum data
c26 N72-21797

Stress corrosion tests of 7XXX series high strength aluminium alloys in laboratory environment
c14 N72-21903

**ALUMINUM ALLOYS**

Radiographic indications film interpreter might encounter during evaluation of aluminum alloy welds
[NASA-CR-123488] c15 N72-21467

Equilibrium surface segregation in copper-aluminum single crystal alloy using Auger electron spectroscopy
[NASA-TM-X-2543] c17 N72-21532

Construction of density of states histogram for AuAl2 using augmented plane wave calculations of the valence and conduction bands
c26 N72-21738

Measurement of soft X ray emission spectrum of aluminum in gold aluminide alloy and comparison orbital state density at aluminum sites
c26 N72-21739

Soft X ray emission from alloys of aluminum with silver, copper, and zinc and comparison with conditions of simple metal alloyed with noble metal
c26 N72-21740

Measurement of soft X ray emission spectra for aluminum-magnesium alloys and comparison with spectra for pure metals
c26 N72-21741

Stress corrosion index for measuring conjoint action between stress and corrosion in stress corrosion of Al alloys
c32 N72-21908

Microelectrodes for measuring pH gradients during stress corrosion of aluminum alloys and 1020 steel exposed to potassium chloride
c17 N72-21909

Krafft model for determining susceptibility of Zn-Mg-Cu aluminum alloys to stress corrosion crack growth
c32 N72-21915

Analysis of crack initiation and crack propagation in high strength Al alloys in different environments
c14 N72-21918

Precracked cantilever beam and long term beam exposure tests for determining stress corrosion of Al alloys in sea water
c17 N72-21919

Smooth beam and precracked specimen testing of stress behavior of aluminum alloys
c17 N72-21920

Stress corrosion in two aluminum alloys
c14 N72-21921

**ALUMINUM OXIDES**

Pack process for introducing alumina into solid solution near surface of thoriated nickel-chromium alloys
[NASA-CR-120880] c17 N72-21526

Dispersion strengthened nickel-alumina alloy produced by comminution and blending
[NASA-TM-X-2548] c17 N72-21533

High temperature, low stress creep in dispersion strengthened gold-alumina alloys
[AD-735710] c17 N72-21549

**AMINES**

Polyimide foams produced in presence of alkanolamine or siloxane-glycol polymer
[NASA-CASE-ARC-10464-1] c06 N72-21102

**AMMONIA**

Coulometric measurement of micro-impurities of nitrogen oxide, sulfur dioxide, and ammonia in gases
[NLL-M-22138-[5828.4F]] c14 N72-21404

**AMORPHOUS MATERIALS**

Localized electron density of states in narrow band and amorphous semiconductor crystalline solids
c26 N72-21763

**AMPLIFICATION**

Gain measurements in amplifier discharge tube under ac excited and pulse discharge conditions
[AD-735334] c16 N72-21511

**AMPLIFIERS**

Positive and negative feedback networks insensitive to variations in amplifier gains
[SCL-DR-710094] c10 N72-21277

**ANALOG TO DIGITAL CONVERTERS**

Wide range analog to digital converter with variable gain amplifier
[NASA-CASE-NPO-11018] c08 N72-21200

**ANALYSIS [MATHEMATICS]**

Solutions to band structure problems
c26 N72-21703

**ANALYTIC FUNCTIONS**

Polynomials orthogonal to holomorphic functions of many complex variables and analog of Riesz-Fischer theorem
[NLL-M-22038-[5828.4F]] c19 N72-21566

**ANGLE OF ATTACK**

Vortex ring method used for calculations of aerodynamic characteristics of helicopter lifting rotors at any angle of attack in flow with comparatively high velocity
[AD-735439] c01 N72-20973

Aerodynamic wind tunnel stability tests for determining fin deflection angle and vertical position of frustrum of space shuttle at high angles of attack
[NASA-CR-120040] c31 N72-21889

**ANGULAR CORRELATION**

Determination of relative angular position of spacecraft and radiating celestial body
[NASA-CASE-GSC-11444-1] c14 N72-21418

**ANGULAR DISTRIBUTION**

Angular deviations of radio waves from horizontal stratification
c07 N72-21139

**ANGULAR MOMENTUM**

Energy level calculation for ionized thulium using total angular momentum states of 4f12 configuration
[AD-735319] c06 N72-21112

Angular behavior of K/Pi ratio at high energy in multi-Regge model
[NOTA-INTERNA-338] c24 N72-21688

**ANIMALS**

Automatic pair feeding device for controlled feeding of test animals
[NASA-CASE-ARC-10302-1] c04 N72-21052

**ANNEALING**

Methods for determining types of structural elements occurring during annealing of worked metals
[NLL-RTS-6799] c17 N72-21516

Microstructure and mechanical properties of superalloy produced by gradient-annealing prealloyed powder extrusions
[NASA-TM-X-2545] c17 N72-21527

**ANNIHILATION REACTIONS**

Subroutines for calculation of spin matrix elements of antiproton-neutron annihilation using Zemach relativistic method
[NOTA-INTERNA-328] c24 N72-21683

**ANNUAL VARIATIONS**

Tabulation of geomagnetic data recorded by Spanish geophysical observatories in 1968
c13 N72-21372

Annual and secular variations of North Atlantic temperature, based on data for 1881 through 1962
[NLL-M-22214-[5828.4F]] c20 N72-21584

**ANTARCTIC REGIONS**

Computer analysis of clothing and human acclimatization to Antarctic Region
[AD-734071] c04 N72-21055

**ANTENNA ARRAYS**

Radiation characteristics of horizontal loop antenna arrays
[AD-734599] c07 N72-21166

Use of high frequency antenna arrays to reduce conduction losses normally associated with antenna operating on or in proximity to earth surface
[AD-735682] c07 N72-21173

Vertically stacked collinear array of independently fed omnidirectional antennas for use in collision warning systems on commercial aircraft
[NASA-CASE-LAR-10545-1] c09 N72-21244

Scanning characteristics of near field Cassegrainian antenna excited with small planar array
[AD-735661] c09 N72-21264

**ANTENNA COUPLERS**

Signal propagation at 400 kHz in oak trees using HEMAC
[AD-735330] c07 N72-21178

Utilization of natural plant growth to model HF-VHF radio transmission in jungle forest type terrain
[AD-735335] c07 N72-21180

**ANTENNA RADIATION PATTERNS**

Numerical-analytical techniques for predicting radiation patterns and impedance of aircraft antennas including effects of outboard members of aircraft structure
[AD-735346] c07 N72-21171

Detection and control of radiation pattern nulls in phased arrays
[AD-735653] c07 N72-21179

**ANTHRACENE**

Double injection and electroluminescence in doped anthracene crystals
[NLL-TRANS-2818-[9022.81]] c26 N72-21700

**ANTHROPOMETRY**

Anthropometric requirements for entrance into naval flight training program
[AD-735101] c04 N72-21067

**ANTIFERROMAGNETISM**

Magnetic hyperfine structure and Mossbauer effect in rubidium and potassium fluorides
[BNL-16326] c06 N72-21107

Antiferromagnetic and paramagnetic states of half-filled narrow energy band investigated using t-matrix method
c26 N72-21768

**ANTIICING ADDITIVES**

Fungicidal potency of antiicing additive for jet fuel
[AD-735451] c04 N72-21068

**ANTIMISSILE DEFENSE**

Uniformity theorems for purchase of defensive weapon systems
[AD-735260] c34 N72-21985

**ANTIPARTICLES**

Discovery of antihelium 3 nuclei and excitons
[NLL-M-22112-[5828.4F]] c34 N72-21966

**APERTURES**

Electron microscope and method of making annular objective aperture
[NASA-CASE-ARC-10448-1] c14 N72-21421

**APOLLO 12 FLIGHT**

Analysis of microdensitometer measurements of Apollo 12 photographs of clouds caused by venting liquids into space
[NASA-CR-125934] c31 N72-21885

**APOLLO 14 FLIGHT**

Luminescence and geological analysis of Apollo 14 and 15 lunar soil and rock samples
[NASA-CR-115494] c30 N72-21858

Luminescence analyses of lunar rocks brought back by Apollo 14 and 15
[NASA-CR-115512] c30 N72-21860

**APOLLO 15 FLIGHT**

Luminescence and geological analysis of Apollo 14 and 15 lunar soil and rock samples
[NASA-CR-115494] c30 N72-21858

Luminescence analyses of lunar rocks brought back by Apollo 14 and 15
[NASA-CR-115512] c30 N72-21860

**APPROXIMATION**

Evaluation of Jacobian determinants occurring in classical mechanical and quasiclassical approximation descriptions of molecular scattering
[NASA-CR-125978] c06 N72-21095

Algorithm for approximate solution of vector Toeplitz systems
[UCRL-73495] c19 N72-21571

Measuring noncommuting operators in quantum detection and estimation theory
[NASA-CR-122364] c24 N72-21675

**APTITUDE**

Motion picture test for air traffic control aptitude for use in personnel selection and evaluation
[AD-735942] c05 N72-21085

**AQUEOUS SOLUTIONS**

Redox equilibria, thermodynamic properties of aqueous systems, and electrochemistry of aqueous systems and molten salts
[STU-68-261-U-208] c17 N72-21542

Threshold stress intensity values and crack propagation rates for stress corrosion of high strength steels in aqueous environment
c32 N72-21913

**ARCTIC OCEAN**

Properties of discretely stratified microstructure in Arctic Ocean
[AD-734973] c13 N72-21379

Ice conditions and surface profiles in Arctic Ocean
[AD-735871] c13 N72-21389

**ARCTIC REGIONS**

Models of Arctic ionosphere
c13 N72-21123

Arctic ionogram sequences and auroral oval
c13 N72-21125

Arctic research including studies of ice albedo, acoustic telemetry, and ice pack support vehicle
[AD-735957] c13 N72-21383

**ARGON**

Development and characteristics of shock tube for analyzing argon plasma optical properties
[FRNC-TH-70] c11 N72-21302

Vibrational relaxation for gaseous mixtures of CO and Ar using rapid heating and cooling rates
[DLR-FB-71-62] c12 N72-21315

Heat conductivity of argon in shock tubes at 5000 K
[NLL-M-22129-[5828.4F]] c33 N72-21950

**ARMED FORCES [UNITED STATES]**

Application of systems engineering concept to US Coast Guard aviator training programs
[AD-735051] c05 N72-21080

**AROMATIC COMPOUNDS**
Fluorescence, phosphorescence, and triplet quantum yields for organic molecules in rigid plastic media as function of temperature
[AD-735483] c06 N72-21113
Effects of high pressure on spectroscopic properties of aromatic hydrocarbons
[AD-735163] c06 N72-21116

**ARRHYTHMIA**
Experimental and clinical studies in treating digitalis caused cardiac arrhythmias with sodium citrate using heart patients and dogs
[NASA-TT-F-14194] c04 N72-21045

**ARSENIC**
Infrared reflectivity of arsenic correlated with Fermi surface, magnetoreflection and optical reflectivity measurements
c18 N72-21707

**ARTIFICIAL CLOUDS**
Measurement of peak electron density in barium clouds as function of time using multifrequency, high frequency radar observations
[AD-736040] c12 N72-21328
One dimensional analysis of expansion of gas cloud into vacuum to determine cause of ring structure of neutral gas cloud during barium cloud experiments
[NASA-TN-D-6760] c30 N72-21859

**ARTIFICIAL HEART VALVES**
Vapor cycle engine for driving Pu 238 fueled heart assist system
[PB-205474] c05 N72-21086

**ARTIFICIAL SATELLITES**
High latitude studies of scintillation in radio signals from radio sources and satellites
c07 N72-21137
Air traffic control analysis of North Atlantic commercial aircraft operation based on inertial navigation and satellite surveillance
[DOT-TSC-FAA-71-13] c21 N72-21629

**ARTILLERY FIRE**
Meteorological data tables for launching 12804 Lance missile number 2120 round number 137
[AD-735359] c20 N72-21607
Meteorological data tables for launching 11604 Lance missile number 5129 round number 138 RMT
[AD-735360] c20 N72-21608
Meteorological data tables for launching Honest John missile number 354, round number 613 RML
[AD-735354] c20 N72-21621

**ASSAYING**
Gamma ray assay for verifying U-235 content in fuel pins
[ANL-7839] c22 N72-21657

**ASSEMBLY LANGUAGE**
Pseudo-random number generating programs in Assembly language for random values from discrete probability distributions
[AD-735144] c19 N72-21577

**ASTRONAUT TRAINING**
Abstracts on space biology and medicine involved in cosmonaut training
[JPRS-55687] c04 N72-21043

**ASTRONOMICAL MODELS**
Cosmological models and counts of discrete extragalactic radio sources at various levels of flux density
[AD-734377] c29 N72-21853

**ATHENA ROCKET VEHICLE**
Performance test to determine effectiveness of third stage destruct system on Athena rocket vehicle propulsion system
[AD-735289] c28 N72-21826

**ATLANTIC OCEAN**
Anomalies in North Atlantic Ocean temperature and ocean-atmosphere temperature differences preceding and during severe 1968-1969 winter
[NLL-M-22215-[5828.4F]] c20 N72-21583
Annual and secular variations of North Atlantic temperature, based on data for 1881 through 1962
[NLL-M-22214-[5828.4F]] c20 N72-21584
Analysis of air traffic control procedures employed on air routes over North Atlantic Ocean
[PB-204862] c21 N72-21642

**ATMOSPHERIC ATTENUATION**
Determination of atmospheric absorption coefficient in shortwave region of decimeter range
[NLL-M-22050-[5828.4F]] c13 N72-21349

**ATMOSPHERIC CIRCULATION**
Vertical and horizontal distributions of atmospheric kinetic energy in June and Jan. over northern and southern USSR
[NLL-M-22049-[5828.4F]] c20 N72-21581

**ATMOSPHERIC COMPOSITION**
Absorption spectra of atmospheric gases in vacuum ultraviolet regions
[NLL-M-22123-[5828.4F]] c13 N72-21352
Manmade and natural radioactivity in atmosphere
[AEC-TR-7268] c13 N72-21370

**ATMOSPHERIC CONDUCTIVITY**
Dayside auroral, oval plasma density and conductivity enhancement due to magnetosheath electron precipitation
[NASA-CR-125929] c13 N72-21354

**ATMOSPHERIC DENSITY**
Atmospheric density model and drag data from OV-1 satellite at altitudes below 200 km
[AD-735664] c13 N72-21397

**ATMOSPHERIC ENTRY**
Orbital and entry tracking accessory mounted on global map to provide range requirements for reentry vehicles to any landing site
[NASA-CASE-LAR-10626-1] c14 N72-21416

**ATMOSPHERIC MODELS**
Models of Arctic ionosphere
c13 N72-21123
Ionospheric propagation model and application to high latitude HF radar propagation
c07 N72-21153
Atmospheric model for echoes from weak D region disturbances
[AD-735514] c13 N72-21386
Atmospheric density model and drag data from OV-1 satellite at altitudes below 200 km
[AD-735664] c13 N72-21397
Measurement of wind and temperature profiles and turbulent fluctuations in wind velocity under homogeneous turbulence
[AD-735393] c20 N72-21603
Macroscale update weather forecast model for numerical hemispheric forecasts
[AD-735742] c20 N72-21606
Precise particular solutions to prognostic nonlinear problems for long range weather forecasting
[AD-736485] c20 N72-21623

**ATMOSPHERIC TEMPERATURE**
Statistical analysis of temperature regime in Tashkent during Jan. and Feb. 1949 to 1964 for weather forecasting
[NLL-M-22065-[5828.4F]] c20 N72-21582
Anomalies in North Atlantic Ocean temperature and ocean-atmosphere temperature differences preceding and during severe 1968-1969 winter
[NLL-M-22215-[5828.4F]] c20 N72-21583
Computer produced diurnal temperature and dew point tables and curves and their use in short-range weather forecasting
[AD-735276] c20 N72-21614
Thermal parameters for predicting precipitation type for Loring AFB, Maine
[AD-735724] c20 N72-21616

**ATOMIC COLLISIONS**
Atomic hydrogen maser with automatic bulb temperature control to eliminate frequency shift due to collision of hydrogen atoms with storage bulb walls
[NASA-CASE-HQN-10654-1] c16 N72-21502

**ATOMIC ENERGY LEVELS**
Energy level calculation for ionized thulium using total angular momentum states of 4f12 configuration
[AD-735319] c06 N72-21112
X ray photoelectron spectroscopic measurements of valence bands of AuAl2 and AuGa2, and gold 5d band dilemma
c26 N72-21796

**ATOMIC STRUCTURE**
Papers presented at conference on electronic density of states in solids and liquids
[NBS-SP-323] c26 N72-21702
Photoemission and optical measurement studies of electronic structure of vapor deposited molybdenum films
[NASA-CR-126041] c26 N72-21727
Application of soft X ray band spectra to determine similarities and differences between one electron spectrum and density of states
c26 N72-21737
Application of soft X ray spectroscopy for determining electronic properties of titanium interstitial and intermetallic compounds
c26 N72-21743
Concave grating spectrometer analysis of emission band for silicon and energy range of emission band for germanium
c26 N72-21744
Application of positron annihilation for measuring density of states in alpha and beta brass
c26 N72-21745
Application of Compton scattering effect for measuring ground state electronic linear momentum distribution function for lithium and sodium
c26 N72-21746
Application of ion-neutralization spectroscopy for determining local density of states of solids at solid surface
c14 N72-21747
Determination of density of states by analyzing current-voltage characteristics in field emission resonance tunneling in junctions
c26 N72-21749
Numerical analysis of density conditions necessary for production of phase transition in solids
c26 N72-21750
Application of chemical bond relationships to determine electronic density of states
c26 N72-21751
Application of electroreflectance techniques to determine band population effects in indium antimonide
c26 N72-21752
Measurement of electroreflectance spectra of semiconductor materials for identification of energy multiplets and spin-orbit splittings
c26 N72-21753
Atomic Structure of disordered alloys
c26 N72-21758
Generalized coherent potential theory of electronic structure of disordered systems
[NASA-CR-126044] c26 N72-21764
Correlation of changes in Knight shift and soft X ray emission edge height of aluminum in Al metal, alloys, and oxide
c26 N72-21780

**ATTACKING [ASSAULTING]**
Mathematical models for determining influence of weather forecasts on military operational decisions
[AD-735261] c20 N72-21602

**ATTENUATION**
Ultrahigh energy cosmic ray attenuation due to hadron production
[RIFP-142] c29 N72-21830

**ATTENUATION COEFFICIENTS**
Attenuation coefficient of third sound in liquid He film and stability of quantized persistent calculations of thin helium film in Landau region
[AD-735924] c33 N72-21964

**ATTITUDE CONTROL**
Development of rotation law for application to Skylab gyroscopes to avoid gimbal stop encounters
[NASA-CR-126140] c21 N72-21633

**ATTITUDE INDICATORS**
Preferred motion relationships for flight director display
[AD-735916] c14 N72-21456

**AUDITORY PERCEPTION**
Doppler discrimination in high background noise of rotary winged aircraft
[AD-734118] c04 N72-21056

**AUDITORY SENSATION AREAS**
Medical research abstracts on limulus visual system, electronic neuron model development, and auditory adaptation in horseshoe crab
[AD-734017] c04 N72-21073

**AUGER EFFECT**
Equilibrium surface segregation in copper-aluminum single crystal alloy using Auger electron spectroscopy
[NASA-TM-X-2543] c17 N72-21532

**AURORAL ARCS**
Development of theory for formation of stable auroral red arcs at plasmapause
[AD-736431] c13 N72-21403

**AURORAL IONIZATION**
Forward and backscattering caused by wave interaction with auroral ionization and theories of irregularity production
c07 N72-21126

**AURORAL SPECTROSCOPY**
Centaur sounding rocket Wadsworth spectrograph experimental design for auroral emission spectrophotographic recording
[ESRO-SM-80] c14 N72-21444

**AURORAS**
Arctic ionogram sequences and auroral oval
c13 N72-21125
Auroral radar network for statistical and single event studies of radio aurora morphology and scattering mechanisms
c13 N72-21127
VHF bistatic CW auroral backscattering and influence of daytime, seasonal, and geomagnetic latitude
c13 N72-21128
Radar aurora studies using backscatter radar
c07 N72-21129
Radar aurora at frequency of 1295 MHz
c07 N72-21130
Radio wave scattering from auroral ionization
[NASA-TM-X-68302] c07 N72-21131
Ion-acoustic waves in auroral plasma and radio wave scattering
c13 N72-21132
Simulation and investigation of scattering mechanisms of radio aurora
c07 N72-21135
Polar propagation effects on HF radar in auroral and subauroral regions
c07 N72-21142
Power spectral densities, Doppler shifts, and phase fluctuations of frequency distortion in auroral HF propagation
c07 N72-21143
Spatial correlation of auroral radio absorption, using riometers
c07 N72-21146
HF auroral backscatter, scintillation theory, and satellite beacon recordings
c07 N72-21150
Narrow and wideband FM/CW HF backscatter observations of radio aurora
c07 N72-21151
Dayside auroral, oval plasma density and conductivity enhancement due to magnetosheath electron precipitation
[NASA-CR-125929] c13 N72-21354

Proceedings of institute for aurora and airglow investigations during 1970
[AD-735151] c13 N72-21384

Meteorology, geomagnetism, auroras, airglow, and ionosphere - bibliography
c34 N72-21974

**AUSTENITIC STAINLESS STEELS**

Preparation and mechanical properties of austenitic stainless steel weldments
[HEDL-TME-71-118] c15 N72-21490

Nitrogen content and microstructure in austenitic stainless steels
[TID-25783] c17 N72-21539

Effect of tungsten and molybdenum on softening and structure of chromium-nickel austenitic stainless steel
[AD-735466] c17 N72-21548

**AUTOCORRELATION**

Complex spatial filters in coherent optical correlators recorded by Fourier transform method
[NASA-TN-D-6581] c23 N72-21661

**AUTOMATIC CONTROL**

Tests of remote automatic multipurpose station early warning system telemetry transmissions
[AD-736221] c07 N72-21195

Growth capabilities and future automation of TACC data base security and limitation requirements
[AD-735732] c08 N72-21238

Plotter device for automatically drawing equipotential lines on sheet of resistance paper
[NASA-CASE-NPO-11134] c09 N72-21246

Command and control systems for automatically controlled and guided vehicle
[PB-205013] c34 N72-21983

**AUTOMATIC FREQUENCY CONTROL**

Automatic frequency control device for providing frequency reference for voltage controlled oscillator
[NASA-CASE-KSC-10393] c09 N72-21247

**AUTOMATIC PILOTS**

Adaptive control autopilot for identifying tactical missile
[AD-735488] c31 N72-21899

**AUTOMATIC TEST EQUIPMENT**

Automatic pair feeding device for controlled feeding of test animals
[NASA-CASE-ARC-10302-1] c04 N72-21052

Pressure ramp programmer for automatic blood pressure measurements
[NASA-CR-115508] c05 N72-21074

Automated visual sensitivity tester for determining visual field sensitivity and blind spot size
[NASA-CASE-ARC-10329-1] c05 N72-21079

**AUTOMATION**

Development of system for near real time automatic recognition of spoken words
[AD-735723] c07 N72-21182

**AUTOMOBILE ACCIDENTS**

Methods of measuring vehicle occupant motion during crash or impact and evaluation of restraint system performance
[PB-204809] c14 N72-21447

Analysis of methods for measuring vehicle occupant motion during crash or impact and evaluation of restraint system performance
[PB-204808] c14 N72-21448

Anticipatory sensing of impending automobile accidents using microwave radar and ultrasonic sonar
[PB-204806] c14 N72-21449

**AUTOMOBILES**

High energy secondary batteries for pollution-free electric automobiles
[PB-205254] c03 N72-21039

Analysis of pedal operation by seated operator with application to design of foot controls for automobiles and other equipment
[AD-735315] c05 N72-21089

**AUXILIARY POWER SOURCES**

Exhaust emissions tests of aircraft propulsion and auxiliary power gas turbine engines
[PB-204920] c02 N72-21018

**AVIONICS**

Military research in microelectronics, chemical lasers, gas lasers, and avionics
[AD-735869] c34 N72-21986

**AZIMUTH**

Measurement of relative azimuth bearing using laser source for projecting collimated beam
[NASA-CASE-GSC-11262-1] c16 N72-21503


## B


**BACKGROUND NOISE**

Doppler discrimination in high background noise of rotary winged aircraft
[AD-734118] c04 N72-21056

**BACKGROUND RADIATION**

Balloon measurements of far infrared background radiation
[NASA-CR-125936] c13 N72-21355

**BACKSCATTERING**

Forward and backscattering caused by wave interaction with auroral ionization and theories of irregularity production
c07 N72-21126

VHF bistatic CW auroral backscattering and influence of daytime, seasonal, and geomagnetic latitude
c13 N72-21128

Radar aurora studies using backscatter radar
c07 N72-21129

Sweep frequency backscatter radars as detectors of high latitude ionospheric phenomena
c07 N72-21147

High frequency backscatter observations of high latitude, field aligned irregularities in F region
c07 N72-21149

HF auroral backscatter, scintillation theory, and satellite beacon recordings
c07 N72-21150

Narrow and wideband FM/CW HF backscatter observations of radio aurora
c07 N72-21151

Models for sound propagation and reverberation, surface backscattering coefficients, and sonar performance prediction
[AD-735995] c13 N72-21390

**BACTERIA**

Lyophilized spore dispenser for production of finely divided monoparticulate cloud of bacterial spores
[NASA-CASE-LAR-10544-1] c15 N72-21477

**BAGGAGE**

Simulation of turnaround operation of passenger aircraft using critical path method for improving aircraft/terminal utilization
c34 N72-21970

**BALL BEARINGS**

First-order thrust load analysis of arched-outer-race ball bearing with consideration of centrifugal forces
[NASA-TN-D-6765] c15 N72-21470

**BALLISTIC RANGES**

Case histories of international cooperation in field of ballistic ranges, sonic boom generators and simulation of nuclear blast in galleries
[ISL-4/71] c11 N72-21304

**BALLISTIC TRAJECTORIES**

Tests of proposed ballistic wind determination technique using SIRS data from Nimbus 3 and 4 satellites
[AD-735898] c13 N72-21393

**BALLISTICS**

Meteorological and ballistics data for launching of Lance missile 2105, round 134
[AD-735357] c20 N72-21618

Effectiveness of synergistic catalyst systems in altering ballistic parameters of composite solid propellants
[AD-736222] c27 N72-21814

**BAND STRUCTURE OF SOLIDS**

Papers presented at conference on electronic density of states in solids and liquids
[NBS-SP-323] c26 N72-21702

Solutions to band structure problems
c26 N72-21703

Electronic band structures and densities of states for two intermetallic compounds having CsCl structure
c26 N72-21704

Linear combination of atomic orbitals interpolation method for calculating electron density of crystalline solid
c26 N72-21705

Calculating band structure of ferromagnetic iron by variational method using tight binding functions and orthogonalized plane waves
c23 N72-21708

Calculation of density of states in W, Ta, and Mo from corresponding energy band structure
c26 N72-21709

Adjustment of calculated band structures for calcium by use of low temperature specific heat data
c26 N72-21710

Effects of compression on band structure and density of states of alkaline metals by augmented plane wave method
c26 N72-21712

Parametrization techniques used for obtaining band structure for density of state calculations
c26 N72-21713

Band structure of tungsten in energy region of 5d bands by photoelectric spectroscopy
c26 N72-21725

Soft X ray spectroscopic method for recording L series valence band spectra in iron, cobalt, nickel, copper, and zinc
[NASA-CR-126042] c26 N72-21742

Nonlocalization of electron states at middle of continuous band for three dimensional model of tightly bound electrons with cellular disorder
c26 N72-21767

Direct and exchange core polarization contributions to spin susceptibility and relation of spin susceptibility and density of states for Mg and Cd
c26 N72-21779

Potential-independent feature of crystal band structure
[NASA-CR-126045] c26 N72-21791

Band structure and density of states in zincblende-type semiconductors used to calculate nonlinear optical susceptibility responsible for second harmonic generation
c26 N72-21792

**BANDPASS FILTERS**

Resonators for diplexers in multiplexing network noting bandpass filters and coplanar waveguides
[ESRO-CR-46] c07 N72-21164

Analysis of parameters of Riordan gyrator and application as simulated inductor in electric filter networks
[AD-736533] c09 N72-21271

**BARIUM**

Development of optical striations and Doppler spectrum broadening due to barium plasmas in ionosphere
c07 N72-21136

Measurement of peak electron density in barium clouds as function of time using multifrequency, high frequency radar observations
[AD-736040] c12 N72-21328

One dimensional analysis of expansion of gas cloud into vacuum to determine cause of ring structure of neutral gas cloud during barium cloud experiments
[NASA-TN-D-6760] c30 N72-21859

**BARIUM TITANATES**

Memory device employing semiconductor and ferroelectric properties of single crystal barium titanate
[NASA-CASE-ERC-10307] c08 N72-21198

**BATHYMETERS**

Bathymetric chart of Carmel Bay
[AD-734986] c13 N72-21380

**BEACHES**

Computerized simulation of relationships between barometric pressure, wind, waves, and currents on eastern shore of Lake Michigan
[AD-736224] c13 N72-21401

**BEAM LEADS**

Beam lead integrated circuit package and method for preparing lead frame array
[NASA-CASE-MFS-21374] c10 N72-21274

**BEAM SPLITTERS**

Optical range finder using reflective first surfaces mirror and transmitting beam splitter
[NASA-CASE-MSC-12105-1] c14 N72-21409

**BEAMS [RADIATION]**

Estimation of beam spread of laser beam propagating in turbulent medium
[AD-735665] c16 N72-21508

**BEAMS [SUPPORTS]**

Superposition principle for nonclassical forced motion of stationary and rotating beams with tip masses
[AD-735683] c32 N72-21939

Acoustic radiation from free-free, point drive beams affected by light and heavy fluid loading
[AD-735873] c32 N72-21944

Finite elements for bars, shafts in torsion, Bernoulli-Euler beams, and Timoshenko beams for shock and vibration analysis
[AD-735923] c32 N72-21946

**BEECHCRAFT AIRCRAFT**

Report of aircraft accident involving Beechcraft 99 air taxi at Allentown, Pennsylvania on 24 October, 1971
[NTSB-AAR-72-3] c02 N72-21002

**BELGIUM**

Activity report for 1970 on mechanical engineering, metallurgy, metallography, selective dissemination of information, and plastics
c34 N72-21976

**BENDING FATIGUE**

Cantilever bending tests for determining susceptibility of high strength alloys to stress corrosion cracking
c14 N72-21911

**BENDING MOMENTS**

Computerized simulation of Skylab 1B vehicle response to winds during propellant loading at launch pad for determining displacements and bending moments
[NASA-CR-123564] c31 N72-21878

**BERYLLIUM**

Processing and parameters for fabrication of controlled permeability porous beryllium billets from powder
[AD-736484] c17 N72-21554

**BETATRONS**

Betatron mode signals in intersecting storage rings and estimates of instability thresholds and growth rates
[CERN-71-15] c24 N72-21681

**BIBLIOGRAPHIES**

KWIC index and bibliography on biological effects related technology of lasers and light
[PB-205091] c04 N72-21070

Bibliography of reported biological responses and clinical manifestations attributed to microwave and radio frequency radiation
[AD-734391] c04 N72-21071

Ultrahigh frequency references containing materials property data in millimeter and submillimeter ranges
[AD-735621] c09 N72-21269

Abstracts, bibliographies, and index on Soviet cybernetics
[AD-735651] c10 N72-21278

Bibliography of reports and simulation models describing air traffic control procedures for all phases of aircraft operation
[DOT-TSC-FAA-71-7] c21 N72-21626

Bibliography on various features of interplanetary and interstellar space
c30 N72-21871

Meteorology, geomagnetism, auroras, airglow, and ionosphere - bibliography
c34 N72-21974

Solar radiation, cosmic rays, satellite orbits, and upper atmosphere structure - bibliography
c34 N72-21975

Transportation systems - bibliography
[PB-204803] c34 N72-21978

**BIMETALS**

Design, development, and evaluation of bimetallic temperature probe for measuring temperature of soil
[NASA-TT-F-14226] c14 N72-21413

**BINARY ALLOYS**

Influence of generalized order-disorder on electron states for various types of binary intermetallic compounds
c26 N72-21762

T matrix theory of electron states in disordered systems used to determine spectral density for states of various symmetries in beta brass
c26 N72-21765

Interpretation of absolute Knight shifts of alkalis, variations with pressure, and absolute Knight shifts in binary alkali systems
c26 N72-21778

**BINARY TO DECIMAL CONVERTERS**

High speed direct binary to binary coded decimal converter for use in PCM telemetry systems
[NASA-CASE-KSC-10326] c08 N72-21197

**BIOASSAY**

Design and implementation of computer program for statistical analysis of biological assays and related quantal data
[AD-735145] c08 N72-21233

**BIOCHEMISTRY**

Research and development on aeronautics, biochemistry, and geophysics
[AD-735897] c34 N72-21987

**BIODYNAMICS**

Effects of exposure to blast induced winds and pressure variations on biophysical parameters
[AD-734208] c04 N72-21054

**BIOENGINEERING**

Optimal control algorithms for on-line closed loop blood pressure regulation
[AD-735900] c05 N72-21088

**BIOINSTRUMENTATION**

Pressure ramp programmer for automatic blood pressure measurements
[NASA-CR-115508] c05 N72-21074

**BIOLOGICAL EFFECTS**

KWIC index and bibliography on biological effects related technology of lasers and light
[PB-205091] c04 N72-21070

**BIONICS**

Medical research abstracts on limulus visual system, electronic neuron model development, and auditory adaptation in horseshoe crab
[AD-734017] c04 N72-21073

**BITS**

Bit detection methods and detectors for FSK and PSK modulated data
c07 N72-21294

**BLAST DEFLECTORS**

Jet blast deflector for controlling shipboard flight deck environment
[AD-735877] c33 N72-21963

**BLAST LOADS**

Effects of exposure to blast induced winds and pressure variations on biophysical parameters
[AD-734208] c04 N72-21054

**BLOOD**

Glycolytic metabolism effects from responses of blood lactate-pyruvate and redox state to chronic exposure to 3 percent CO2
[AD-734122] c04 N72-21059

**BLOOD CIRCULATION**

Whole body plethysmograph system for use in measuring airway resistance under ambient hyperbaric conditions for normal breathing patterns
[AD-735462] c05 N72-21081

**BLOOD COAGULATION**

Effects of prolonged exposure to hyperoxia environment on coagulating processes of blood
[JPRS-55553] c04 N72-21044

**BLOOD PRESSURE**

Pressure ramp programmer for automatic blood pressure measurements
[NASA-CR-115508] c05 N72-21074

Optimal control algorithms for on-line closed loop blood pressure regulation
[AD-735900] c05 N72-21088

**BODIES OF REVOLUTION**

Thermoelastic stress conditions and heat conductivity of plates and bodies of revolution
[AD-735582] c33 N72-21961

**BODY CENTERED CUBIC LATTICES**

Numerical analysis of density of electron states in metals based on soft X ray transitions in solids
c26 N72-21731

Potential-independent feature of crystal band structure
[NASA-CR-126045] c26 N72-21791

**BODY KINEMATICS**

Effectiveness of restraint equipment in controlling head impact forces and body kinematics in enclosed aircraft areas
[FAA-AM-72-6] c05 N72-21078

**BODY TEMPERATURE**

Response of ventilation parameters, pulse rate, oxygen uptake, and body temperature in man under acute and severe hypoxia
[DLR-FB-71-65] c04 N72-21053

**BODY WEIGHT**

Sham-exposed controls and body weight variation in primates exposed to 55 MeV protons
[AD-734779] c04 N72-21066

**BOEING 747 AIRCRAFT**

Flight test program and data acquisition techniques for evaluation of Boeing 747 aircraft
c02 N72-20977

**BOILING**

Boiling point depressor and absorbent in constant total pressure evaporation process with heat reuse by built-in engine
[PB-204619] c33 N72-21960

**BORIDES**

Developing boride composites with metal additives for lowering fabrication temperatures and increasing impact strength
[NASA-CR-126246] c18 N72-21555

**BORON COMPOUNDS**

Measurement of static strength of lap bolted joints of fibrous composite material reinforced with boron film
[AD-735953] c15 N72-21493

**BOUNDARY LAYER CONTROL**

Torpedo drag reduction, using MHD boundary layer control and assuming nonzero electric field
[AD-735471] c12 N72-21320

**BOUNDARY LAYER FLOW**

Nonequilibrium boundary layer flow at leading edge of highly swept hypersonic infinite span wing
[PB-204710] c01 N72-20975

**BOUNDARY VALUE PROBLEMS**

Method for numerically solving class of two-point boundary value problems in optimal control theory
[NASA-TM-X-58088] c19 N72-21567

Optimal control problems with lags
[AD-735475] c19 N72-21572

Nonisothermal theory of elastic Cosserat surface and linear equations characterizing initial boundary value problems
[AD-735927] c32 N72-21937

Correctness of problem with initial conditions for partial differential equation in numerical weather forecasting
[AD-735507] c34 N72-21981

**BRASSES**

Application of positron annihilation for measuring density of states in alpha and beta brass
c26 N72-21745

T matrix theory of electron states in disordered systems used to determine spectral density for states of various symmetries in beta brass
c26 N72-21765

**BRAZING**

In-process monitors, parellel-gap brazing of flexible copper circuit terminations, and copper alloy determination
[BDX-613-472] c09 N72-21256

**BREEDER REACTORS**

Reactor shielding for fast test and liquid metal fast breeder reactors
[ORNL-TM-3639] c22 N72-21654

**BRIGHTNESS DISCRIMINATION**

Automated visual sensitivity tester for determining visual field sensitivity and blind spot size
[NASA-CASE-ARC-10329-1] c05 N72-21079

**BRIGHTNESS TEMPERATURE**

Extensive 3.3 mm observations yielding disk average brightness temperatures for Mars, Jupiter, Saturn, and Uranus and variation search with time or phase angle
[AD-728204] c30 N72-21876

**BROADBAND**

Two broadband amplifier chains
[AD-735755] c09 N72-21268

**BUCKLING**

Test equipment to prevent buckling of small diameter specimens during compression tests
[NASA-CASE-LAR-10440-1] c14 N72-21420

Buckling of stiffened and unstiffened cylindrical and conical shells
[AD-736044] c32 N72-21947

**BULBS**

Atomic hydrogen maser with automatic bulb temperature control to eliminate frequency shift due to collision of hydrogen atoms with storage bulb walls
[NASA-CASE-HQN-10654-1] c16 N72-21502

**BUOYS**

Survey of techniques for determining meteorological data by remote sensing from automatic data buoy platforms
[PB-204793] c14 N72-21452

**BURNING RATE**

Characteristics of solid propellant rocket engines for delivering high thrust with short impulse duration
[AD-735381] c28 N72-21823


## C


**C-5 AIRCRAFT**

Tests to determine design feasibility of unsurfaced soil facilities for operations of C-5A aircraft
[AD-735344] c13 N72-21398

**CADMIUM**

Thermal expansion coefficient of activated vacancy in Zn and Cd
[RPI-3820-5] c17 N72-21545

Direct and exchange core polarization contributions to spin susceptibility and relation of spin susceptibility and density of states for Mg and Cd
c26 N72-21779

**CADMIUM ALLOYS**

Fermi surface topology information on indium cadmium alloy system from superconductivity measurements
c26 N72-21788

**CALCIUM**

Adjustment of calculated band structures for calcium by use of low temperature specific heat data
c26 N72-21710

**CALCULUS OF VARIATIONS**

Calculating band structure of ferromagnetic iron by variational method using tight binding functions and orthogonalized plane waves
c23 N72-21708

**CALIBRATING**

Plastic sphere for radar tracking and calibration
[NASA-CASE-XLA-11154] c07 N72-21117

Dynamic performance characteristics of large amplitude sinusoidal pressure generator used to calibrate pressure transducers
[NASA-CR-120874] c14 N72-21428

**CAMERAS**

Mechanical exposure interlock device for preventing film overexposure in oscilloscope camera
[NASA-CASE-LAR-10319-1] c14 N72-21423

**CANADA**

Role of air cargo in Canadian transportation for period 1967 to 1987
c34 N72-21969

**CANTILEVER BEAMS**

Laboratory equipment for testing stress corrosion of bolt loaded WOL specimens and monitoring crack growth
c32 N72-21914

Acoustic emission technique for determining crack growth rate in high strength cantilever steel type specimens
c14 N72-21917

Precracked cantilever beam and long term beam exposure tests for determining stress corrosion of Al alloys in sea water
c17 N72-21919

**CAPACITANCE**

Comparing transition of capacitance predicted by acoustic theory and that measured in lumped parameter fluid circuit
[AD-735704] c12 N72-21325

**CAPACITORS**

Fabrication and experimental analysis of metal insulator semiconductor devices for radiation vulnerability studies
[AD-735947] c26 N72-21804

**CAPE KENNEDY LAUNCH COMPLEX**

Impact of KSC operations on environment
[NASA-TM-X-67740] c11 N72-21289

**CAPTIVE TESTS**

Performance test to determine effectiveness of third stage destruct system on Athena rocket vehicle propulsion system
[AD-735289] c28 N72-21826

**CARBON**

Solubility of carbon in niobium
c18 N72-21523

Rhenium adsorption in activated carbons
[NASA-TT-F-14250] c17 N72-21535

Vacuum ultraviolet multiplets for ionized carbon and oxygen, and absolute emission cross sections
[NASA-TM-X-65864] c24 N72-21676

**CARBON DIOXIDE**

Lactate-pyruvate and redox state responses of blood and tissue in chronic hypercapnia
[AD-734120] c04 N72-21057

Plasma creatine phosphokinase response to hypercapnia
[AD-734126] c04 N72-21058

Glycolytic metabolism effects from responses of blood lactate-pyruvate and redox state to chronic exposure to 3 percent CO2
[AD-734122] c04 N72-21059

Catalyst cartridge for use in carbon dioxide reduction system utilizing Bosch catalytic reaction
[NASA-CASE-LAR-10551-1] c06 N72-21099
Fast response miniature carbon dioxide detector with no moving parts for measuring concentration in any atmosphere
[NASA-CASE-MSC-13332-1] c14 N72-21408

**CARBON FIBERS**
Measurement of static strength of lap bolted joints of fibrous composite material reinforced with boron film
[AD-735953] c15 N72-21493
Fabrication of carbon fiber composites using high temperature phenylated polyquinoxaline
[AD-735876] c18 N72-21563

**CARBON ISOTOPES**
Methods of carbon isotope separation, thermal diffusion, and low temperature studies
[MLM-1828] c06 N72-21109
Carbon and gaseous isotope separation, diffusion in hydrogen-helium systems, and low temperature He-3 distillation
[MLM-1861] c06 N72-21110

**CARBON MONOXIDE**
Vibrational relaxation for gaseous mixtures of CO and Ar using rapid heating and cooling rates
[DLR-FB-71-62] c12 N72-21315

**CARBON MONOXIDE LASERS**
Atmospheric transmittance near 5 microns and transmittance of CO laser radiation through synthetic atmospheres
[AD-736037] c16 N72-21512

**CARBON TETRACHLORIDE**
Failure of welded joints in Ti-Al-Sn alpha type alloys in CCl4 vapor
c32 N72-21929

**CARDIOVASCULAR SYSTEM**
Characteristics of heart rate information during sleep, and extracting sleep information from heart rate data
[AD-734283] c04 N72-21061
Portable equipment for detecting myocardial activity
[AD-735882] c05 N72-21084

**CARGO**
Low altitude airdrop system using inflation-aided recovery parachutes for extraction
[AD-735375] c02 N72-21013

**CARRIER FREQUENCIES**
Carrier-type transducer with carrier modulation
[NASA-CASE-NUC-10107-1] c09 N72-21254

**CARRIER INJECTION**
Double injection and electroluminescence in doped anthracene crystals
[NLL-TRANS-2818-(9022.81)] c26 N72-21700

**CARTRIDGES**
Catalyst cartridge for use in carbon dioxide reduction system utilizing Bosch catalytic reaction
[NASA-CASE-LAR-10551-1] c06 N72-21099

**CASCADE CONTROL**
Multiloop RC active filter network with low parameter sensitivity and low amplifier gain
[NASA-CASE-ARC-10192] c09 N72-21245

**CASCADE FLOW**
Numerical analysis of oscillatory aerodynamic forces and moments acting on cascade of airfoils in unstalled conditions
[AD-735205] c28 N72-21825

**CASSEGRAIN ANTENNAS**
Scanning characteristics of near field Cassegrainian antenna excited with small planar array
[AD-735661] c09 N72-21264

**CATALOGS**
Catalog of reports on metallurgy subjects for period 1965 through 1971
[AD-735150] c17 N72-21551

**CATALYSIS**
Catalyst cartridge for use in carbon dioxide reduction system utilizing Bosch catalytic reaction
[NASA-CASE-LAR-10551-1] c06 N72-21099

**CATALYSTS**
Effectiveness of synergistic catalyst systems in altering ballistic parameters of composite solid propellants
[AD-736222] c27 N72-21814

**CATHODE RAY TUBES**
Comparative analysis of flat-panel display technology for fixed format applications including plasma display panels, light emitting diodes, electroluminescent films, liquid crystals, and digital-address flat cathode ray tubes
[AD-735329] c09 N72-21270

**CATHODES**
Characteristics of gallium arsenide using either cathode luminescence or trapped electrons
c26 N72-21802

**CAVITATION FLOW**
Numerical analysis and theoretical discussion of effects of high velocity liquid impact and cavitation flow
c12 N72-21314

**CELESTIAL BODIES**
Determination of relative angular position of spacecraft and radiating celestial body
[NASA-CASE-GSC-11444-1] c14 N72-21418

**CELLS (BIOLOGY)**
Effects of high altitude on cellular and energy metabolism in rats
[AD-734933] c04 N72-21064

**CENTRIFUGAL FORCE**
First-order thrust load analysis of arched-outer-race ball bearing with consideration of centrifugal forces
[NASA-TN-D-6765] c15 N72-21470

**CERAMICS**
Polycrystalline oxide ceramic development, densification and porosity change kinetics, and Nd doped yttrium oxide rods as laser material
[AD-736223] c16 N72-21513

**CESIUM COMPOUNDS**
Electronic band structures and densities of states for two intermetallic compounds having CsCl structure
c26 N72-21704
Preparation and crystal structure of KAgO and CsAgO
[NASA-TT-F-14192] c26 N72-21799

**CHANNEL FLOW**
FORTRAN 4 program which computes and plots coordinates for two-dimensional orthogonal mesh in region between wall of flow channel
[NASA-TN-D-6766] c01 N72-20969
Effect of nonuniform heat flux along channel length of critical heat flux for boiling potassium in tubes
[BNL-TR-458] c33 N72-21957

**CHARGE CARRIERS**
Influence of fast neutron bombardment on transport properties of carriers in n-type germanium
[ORO-3651-10] c24 N72-21679
Density of states and numbers of carriers determined from inversions of closed and open Fermi surface data derived from measurements of de Haas van Alpen effect
c26 N72-21795

**CHARGED PARTICLES**
Magnetospheric processes, charged particles, and electric fields
[AD-735149] c13 N72-21388

**CHARTS**
Development of automatic process for compiling thematic and general geographic maps
[AD-736481] c13 N72-21402

**CHEMICAL ANALYSIS**
Development and characteristics of injection system for use with gas chromatograph
[NASA-CASE-ARC-10344-1] c14 N72-21433
Isotope exchange of C[O-18] and C[O-16]2 with O dissolved in metal for volumetric and surface analysis
[NASA-TT-F-14148] c16 N72-21501

**CHEMICAL BONDS**
Application of chemical bond relationships to determine electronic density of states
c26 N72-21751

**CHEMICAL ELEMENTS**
Remote handling device for mixing or analyzing dangerous chemicals
[NASA-CASE-LAR-10634-1] c15 N72-21476

**CHEMICAL LASERS**
Military research in microelectronics, chemical lasers, gas lasers, and avionics
[AD-735869] c34 N72-21986

**CHEMICAL REACTIONS**
Pumping and metering dual piston system and monitor for reaction chamber constituents
[NASA-CASE-GSC-10218-1] c15 N72-21465
Effect of double corona charging units on chemistry of materials used in electrostatic printing process
[AD-735369] c15 N72-21491
Analysis of chemical reactions and electrical exchanges causing pits in stainless steels exposed to an oxidizing chloride medium
[AEC-TR-7289] c17 N72-21543
Effects of repassivation and crack velocity on stress corrosion cracking in alloys
c17 N72-21907

**CHEMICAL TESTS**
Color coded chemical spot test for detecting presence of magnesium and magnesium alloys
[NASA-CASE-LAR-10953-1] c17 N72-21528

**CHLORIDES**
Neutron diffraction and Mossbauer studies of hexagonal linear chain compound, RbFeCl3
[BNL-16327] c06 N72-21106

**CHROMIUM ALLOYS**
Effect of titanium concentration on structure and temperature of brittle-ductile transition in alloys of Cr-Ti-V-B system
c17 N72-21522
Pack process for introducing alumina into solid solution near surface of thoriated nickel-chromium alloys
[NASA-CR-120880] c17 N72-21526

**CHROMIUM BORIDES**
Interaction and marginal wetting angles of chromium and titanium borides with iron and nickel
c17 N72-21518

**CIRCUITS**
Collection of digital circuits with direct application in computer oriented systems
[NASA-SP-5949(01)] c08 N72-21209
Two computer algorithms for obtaining periodic response of nonlinear circuits
[AD-735713] c08 N72-21232
Temperature compensated light source with light emitting diode and circuitry for maintaining luminous power independent of temperature changes
[NASA-CASE-ARC-10467-1] c09 N72-21249
Electrodeless lamp circuit driven by induction
[NASA-CASE-MFS-21214] c09 N72-21252
Processing methods for model quartz crystal units with equivalent circuit parameters and high shock resistance
[AD-735685] c26 N72-21808

**CIRCULAR ORBITS**
Computation of nearly circular satellite orbit perturbation due to geopotential harmonics
[ESRO-SR-13] c30 N72-21873

**CIRCULAR TUBES**
Process for molding long thin-wall tubular bodies from thermosetting plastic molding compounds
[NASA-CASE-LAR-10782-1] c15 N72-21487

**CITRATES**
Experimental and clinical studies in treating digitalis caused cardiac arrhythmias with sodium citrate using heart patients and dogs
[NASA-TT-F-14194] c04 N72-21045

**CIVIL AVIATION**
Briefs of US general aviation aircraft accidents involving missing aircraft and missing aircraft later recovered during 1969
[PB-205097] c02 N72-21021
Briefs of US general aviation aircraft accidents involving air taxi operations during 1969
[PB-205096] c02 N72-21022
Briefs of US general aviation accidents involving aerial application operations during 1969
[PB-204811] c02 N72-21025

**CIVIL DEFENSE**
Radiation measuring instruments designed for civil defense use
[ORNL-TM-3370] c14 N72-21438

**CLEAR AIR TURBULENCE**
Automated forecasting of clear air turbulence by multidimensional contingency tables
[AD-735941] c20 N72-21604

**CLIMATE**
Oceanographic and climatic influence on Indian Ocean thermal structures in upper layers
[AD-734668] c13 N72-21378

**CLIMATOLOGY**
Annual and secular variations of North Atlantic temperature, based on data for 1881 through 1962
[NLL-M-22214-(5828.4F)] c20 N72-21584
Calendar days with 30 mm or more rain in 24 hour period - northwest U.S.S.R.
[NLL-M-22061-(5828.4F)] c20 N72-21586

**CLINICAL MEDICINE**
Experimental and clinical studies in treating digitalis caused cardiac arrhythmias with sodium citrate using heart patients and dogs
[NASA-TT-F-14194] c04 N72-21045
Clinical analysis of hypokinesia caused changes in nervous system and effects of pharmocological preparations on hypokinesia disorders
[NASA-TT-F-14225] c04 N72-21046
Clinical treatment of vibration induced disorders in construction workers
[RAE-LIB-TRANS-1611] c04 N72-21051

**CLOSED ECOLOGICAL SYSTEMS**
Crew facilities and operations for modular space stations
[NASA-CR-121087] c31 N72-21883

**CLOTHING**
Computer analysis of clothing and human acclimatization to Antarctic Region
[AD-734071] c04 N72-21055

**CLOUD COVER**
Computer simulation and statistical analysis of cloud cover and cloud base height
[AD-735213] c20 N72-21601
Meteorological data tables from macro-scale cloud model predictions
[AD-735739] c20 N72-21612
Cloud characteristics on Venus from visual, photometric, polarization, spectrometric, and radio measurements
[AD-734919] c30 N72-21875

**CLOUD HEIGHT INDICATORS**
Computer simulation and statistical analysis of cloud cover and cloud base height
[AD-735213] c20 N72-21601

**CLOUDS (METEOROLOGY)**
Winter orographic cloud modification seeding experiment in Colorado mountains
[PB-205277-F] c20 N72-21599

**COAL**
Device for detection of combustion light preceding explosion in coal mine
[NASA-CASE-LAR-10739-1] c14 N72-21424

**COASTS**
Computerized simulation of relationships between barometric pressure, wind, waves, and currents on eastern shore of Lake Michigan
[AD-736224] c13 N72-21401

Synoptic meteorological data tables of Indias coastal marine areas
[AD-735441] c20 N72-21594

COATINGS
Nonflammable coatings of synthetic mica and silicate gelant solution mixed with latex paint for use in liquid oxygen or high oxygen gaseous atmospheres
[NASA-CASE-MFS-20486] c18 N72-21557
Electrically conducting solar cell doped metal oxide transparent coating for Aeros satellite equipotential surface
c18 N72-21558

COAXIAL PLASMA ACCELERATORS
Coaxial plasma accelerator as projectile accelerator
[NASA-TN-D-6687] c25 N72-21691

COBALT ALLOYS
Cobalt-tungsten alloys with superior strength at elevated temperatures
[NASA-CASE-LEW-10436-1] c17 N72-21538

COEFFICIENT OF FRICTION
Development of methods for determining coefficient of friction and extent of stick-slip friction of magnetic recording tapes
[NASA-CR-125930] c07 N72-21154

COHERENT LIGHT
Complex spatial filters in coherent optical correlators recorded by Fourier transform method
[NASA-TN-D-6581] c23 N72-21661

COHERENT RADIATION
Transmitter receiver system for Helios solar probe using coherent phase modulation
c07 N72-21162
Method and apparatus for producing intense, coherent, monochromatic light from low temperature plasma
[NASA-CASE-XNP-04167-3] c25 N72-21693

COKE
Santa Maria coke, raw materials, hydrogen analysis of commercial cokes and graphites, and image analyzing apparatus
[NASA-CR-125937] c06 N72-21097

COLD ACCLIMATIZATION
Computer analysis of clothing and human acclimatization to Antarctic Region
[AD-734071] c04 N72-21055

COLLIMATION
Measurement of relative azimuth bearing using laser source for projecting collimated beam
[NASA-CASE-GSC-11262-1] c16 N72-21503

COLLISION AVOIDANCE
Numerical analysis of aircraft collision probability due to reduced separation intervals and arbitrary flight paths
[DOT-TSC-FAA-71-27] c02 N72-20997
Vertically stacked collinear array of independently fed omnidirectional antennas for use in collision warning systems on commercial aircraft
[NASA-CASE-LAR-10545-1] c09 N72-21244
Design and development of collision avoidance system for use with general aviation aircraft
[NASA-CR-112023] c21 N72-21625
Economical satellite aided vehicle avoidance system for preventing midair collisions
[NASA-CASE-ERC-10419] c21 N72-21631

COLLISIONLESS PLASMAS
Investigation of high Mach number collisionless electrostatic shocks in plasmas
[IPPJ-119] c25 N72-21692

COLLOIDS
Colloidal metallic dispersions and atomic absorption spectrometry
[NASA-TT-F-14232] c17 N72-21536

COLOR
Color coded chemical spot test for detecting presence of magnesium and magnesium alloys
[NASA-CASE-LAR-10953-1] c17 N72-21528

COLOR CENTERS
Acousto-optic interactions and size limiting factors in color center memory systems
[AD-735903] c08 N72-21240

COLOR VISION
Human visual acuity measured by chromatic square wave gratings under luminance conditions
[AD-734931] c04 N72-21063

COLORADO
Winter orographic cloud modification seeding experiment in Colorado mountains
[PB-205277-F] c20 N72-21599

COMBUSTION
Device for detection of combustion light preceding explosion in coal mine
[NASA-CASE-LAR-10739-1] c14 N72-21424

COMETS
Weak solar wind shock heating of comet coma and Venus atmosphere
[TRITA-EPP-72-02] c29 N72-21851

COMMAND AND CONTROL
Passive and active spacecraft control noting data transmission and processing methods
c07 N72-21299
Design, development, and characteristics of flight command system for Mariner Mars 1971
[NASA-CR-126038] c31 N72-21891
Command and control systems for automatically controlled and guided vehicle
[PB-205013] c34 N72-21983

COMMINUTION
Dispersion strengthened nickel-alumina alloy produced by comminution and blending
[NASA-TM-X-2548] c17 N72-21533

COMMUNICATION EQUIPMENT
Analysis of secure communications capability at millimeter wavelengths and various types of weather conditions
[AD-735686] c07 N72-21168
Effect of background photon flux density on performance of infrared vidicons and infrared scanning systems
[AD-735324] c07 N72-21186

COMMUNICATION SATELLITES
Application of communication satellites to provide worldwide maritime communication system
[PB-204860] c07 N72-21191
Design and characteristics of satellite communication system for naval communications
[AD-736115] c07 N72-21192
Characteristics of satellite-to-ground whistler mode communication link
[AD-736429] c07 N72-21194
Analysis of air traffic control procedures employed on air routes over North Atlantic Ocean
[PB-204862] c21 N72-21642
Review of literature dealing with communication satellite technology with emphasis on educational aspects
[NASA-CR-125933] c34 N72-21968

COMMUNICATION THEORY
Signal detection, communication theory, parameter estimation, and network analysis
[AD-735760] c07 N72-21181
Measuring noncommuting operators in quantum detection and estimation theory
[NASA-CR-122364] c24 N72-21675

COMMUTATORS
Commutator for steering precisely controlled bidirectional currents through numerous loads by use of magnetic core shift registers
[NASA-CASE-NPO-10743] c08 N72-21199

COMPARISON
Comparative evaluation of eight higher order languages of general interest in aerospace fields
[NASA-CR-115515] c08 N72-21203

COMPLEX VARIABLES
Polynomials orthogonal to holomorphic functions of many complex variables and analog of Riesz-Fischer theorem
[NLL-M-22038-[5828.4F]] c19 N72-21566

COMPOSITE MATERIALS
Measurement of static strength of lap bolted joints of fibrous composite material reinforced with boron film
[AD-735953] c15 N72-21493
Catalog of reports on metallurgy subjects for period 1965 through 1971
[AD-735150] c17 N72-21551
Developing boride composites with metal additives for lowering fabrication temperatures and increasing impact strength
[NASA-CR-126246] c18 N72-21555
Method for determining wave attenuation in composite materials due to viscoelasticity
[AD-734658] c18 N72-21559
Long term strength of anisotropic composite materials under plane stress
[AD-735434] c18 N72-21560
Unified and rational treatment of theory for fiber reinforced composite materials
[NASA-CR-1974] c32 N72-21932

COMPOSITE PROPELLANTS
Combustion characteristics of $NH_4ClO_4$ composite propellants and effect of solid phase reactions on ballistic properties of composite propellants
[NASA-CR-111940] c27 N72-21809
Effectiveness of synergistic catalyst systems in altering ballistic parameters of composite solid propellants
[AD-736222] c27 N72-21814

COMPRESSIBILITY
Effects of compression on band structure and density of states of alkaline metals by augmented plane wave method
c26 N72-21712

COMPRESSIBLE BOUNDARY LAYER
Computer program for solving compressible nonsimilar boundary layer equations for laminar, transitional, or turbulent flows of perfect gas
[NASA-TM-X-2458] c12 N72-21312

COMPRESSING
Apparatus and method for compression molding of thermosetting plastics
[NASA-CASE-LAR-10489-1] c15 N72-21484

COMPRESSION LOADS
Pressure transducer for systems for measuring forces of compression
[NASA-CASE-NPO-10832] c14 N72-21405

COMPRESSION TESTS
Test equipment to prevent buckling of small diameter specimens during compression tests
[NASA-CASE-LAR-10440-1] c14 N72-21420

COMPTON EFFECT
Application of Compton scattering effect for measuring ground state electronic linear momentum distribution function for lithium and sodium
c26 N72-21746

COMPUTER DESIGN
Simulation model for analyzing different computer system configurations
[NASA-CR-61376] c08 N72-21202
Hardware organization and system design of guidance and control computers
c08 N72-21214
Aerospace computer input-output techniques for consideration in design phase of interfacing equipment
c08 N72-21219

COMPUTER GRAPHICS
On-line, graphic input-output systems
[NASA-CR-126036] c08 N72-21208
Numerical analysis used in computer-aided design and engineering, man computer interactions, computer graphics, and related topics
[AD-735690] c19 N72-21579

COMPUTER PROGRAMMING
Programming characteristics of future guidance and control computers
c08 N72-21216
Data word length considerations for aerospace computer implementation to obtain required precision levels
c08 N72-21217
Complementary software package for use of IHAS 4 computer
[AD-765681] c08 N72-21231
Waveform processing system as flexible on-line graphic interactive tool for signal classification
[AD-735749] c08 N72-21241
Computer programming for interpreting and processing seismic wave data related to earth crust and upper mantle
c13 N72-21341
FORTRAN 4 program for calculating small signal gain and maximum available energy for CO-2-N2-H20 gas dynamic lasers
[AD-735878] c16 N72-21509
Organization of digital computer program for finding root locus of linear, single loop systems
[DLR-FB-71-64] c19 N72-21569
Function minimization for computer programming using modification of multipliers
[PB-205312] c19 N72-21576
Computer program for analysis of transient afterheat temperature and pressure response of gas cooled nuclear reactor
[NASA-CR-120825] c22 N72-21647
Computer programming for determining moderate-to-highly eccentric satellite launch window considering satellite perturbations
[ESRO-SR-15] c30 N72-21874

COMPUTER PROGRAMS
FORTRAN 4 program which computes and plots coordinates for two-dimensional orthogonal mesh in region between wall of flow channel
[NASA-TN-D-6766] c01 N72-20969
Computer analysis of clothing and human acclimatization to Antarctic Region
[AD-734071] c04 N72-21055
Computer program for calculating partial pressure of selected gases from residual gas analyzer ion spectra
[NASA-CR-125938] c06 N72-21096
Software aspects of phase B space shuttle avionics system, emphasizing executive system design
[NASA-CR-115513] c08 N72-21204
Generation and checkout of computer programs for real time control of aerospace vehicles
c08 N72-21215
Theoretical basis and application of computer-aided curve fit and analysis program
[AD-735946] c08 N72-21230
Design and implementation of computer program for statistical analysis of biological assays and related quantal data
[AD-735145] c08 N72-21233
System security hardware, software, and procedural techniques in automated systems
[AD-735728] c08 N72-21234
Programmers manual for generalized digital computer program written in FORTRAN for simulation and/or optimization of arbitrarily defined vehicle flight paths
[AD-735293] c08 N72-21239
Computer program for solving compressible nonsimilar boundary layer equations for laminar, transitional, or turbulent flows of perfect gas
[NASA-TM-X-2458] c12 N72-21312
Using two-dimensional Lagrangian code to computer growth of perturbed interface between perfect gas and aluminum
[LA-4754] c12 N72-21319

Computer program for analysis of general optical systems
[AD-735674] c16 N72-21510
Development of system for position location reporting and control of tactical aircraft using recursive navigation program
[AD-735262] c21 N72-21636
Computer program for economic analysis of managing high level radioactive wastes from reprocessing power reactor fuels
[ORNL-4633] c22 N72-21648
Computer program for analyzing single line Mossbauer data
[NASA-TM-X-2522] c24 N72-21677
Stability and control moment gyro wobble damping of flexible, spinning space stations, using digital computer program
[NASA-CR-115525] c31 N72-21892
Computer program based on finite element method for analysis of stiffened plates under combined in-plane and lateral loads
[AD-735936] c32 N72-21936
Computer programs for calculating elastic stress intensity factors of pressure hulls
[AD-735874] c32 N72-21943
Computer codes for predicting effect of rocket exhaust plume impingement on sensitive space vehicle surfaces
[AD-735722] c33 N72-21962
Computer systems program specifications for modular space station information management system
[NASA-CR-121088] c34 N72-21967
SATAN 2 computer program modification to include counter battery operations, multifire, and simultaneous fire
[AD-735962] c34 N72-21982

**COMPUTER STORAGE DEVICES**
Memory device employing semiconductor and ferroelectric properties of single crystal barium titanate
[NASA-CASE-ERC-10307] c08 N72-21198
Aerospace computer memory technology and application of particular techniques to various system requirements
c08 N72-21218
Acousto-optic interactions and size limiting factors in color center memory systems
[AD-735903] c08 N72-21240

**COMPUTER TECHNIQUES**
Computer produced diurnal temperature and dew point tables and curves and their use in short-range weather forecasting
[AD-735276] c20 N72-21614

**COMPUTERIZED DESIGN**
Numerical analysis used in computer-aided design and engineering, man computer interactions, computer graphics, and related topics
[AD-735690] c19 N72-21579

**COMPUTERIZED SIMULATION**
Simulation model for analyzing different computer system configurations
[NASA-CR-61376] c08 N72-21202
Simulation and optimization on combative and cooperative two vehicles flight paths
[AD-734755] c08 N72-21229
Evaluation of computerized simulation technique for developing search and rescue operational effectiveness
[AD-735418] c11 N72-21305
Computerized simulation of relationships between barometric pressure, wind, waves, and currents on eastern shore of Lake Michigan
[AD-736224] c13 N72-21401
Computer simulation and statistical analysis of cloud cover and cloud base height
[AD-735213] c20 N72-21601
Evaluation of FAA advanced flow control procedures for air traffic control based on digital simulation of New York City air traffic
[DOT-TSC-FAA-72-8] c21 N72-21630
Development of model of airport airside system to simulate aircraft operations and controller functions in terminal area
[PB-204802] c21 N72-21634
Analog and digital computer simulation analysis of performance and control of low-pressure-ratio turbojet engine for drone aircraft
[NASA-TM-X-2537] c28 N72-21817
Computerized simulation of Skylab 1B vehicle response to winds during propellant loading at launch pad for determining displacements and bending moments
[NASA-CR-123564] c31 N72-21878
SATAN 2 computer program modification to include counter battery operations, multifire, and simultaneous fire
[AD-735962] c34 N72-21982

**COMPUTERS**
Computer system using adaptive voting to tolerate failure and operate in fail-operational, fail-safe manner
[NASA-CASE-MSC-13932-1] c08 N72-21206
Small low cost computers with input/output capacities suitable for use in information centers
[NASA-CR-126039] c08 N72-21210
Computerized planning and organization of container transportation
[AD-735436] c15 N72-21492

**CONCENTRATION [COMPOSITION]**
Data reduction for concentration measurements of solid particles in space
[NASA-TT-F-14188] c30 N72-21864

**CONCORDE AIRCRAFT**
Mathematical models for determining flight performance of Concorde aircraft
c02 N72-20978
Methods and instruments for determining performance of Concorde aircraft
c02 N72-20982

**CONDUCTION BANDS**
Metal-semiconductor barrier junction tunneling study of heavily doped n-type silicon density of states function
c26 N72-21784

**CONDUCTIVITY**
Use of high frequency antenna arrays to reduce conduction losses normally associated with antenna operating on or in proximity to earth surface
[AD-735682] c07 N72-21173

**CONFERENCES**
Proceedings of conference on aircraft flight test procedures, data acquisition, data processing, and correlation with wind tunnel test results
[AGARD-CP-85] c02 N72-20976
Characteristics and effects of Arctic ionosphere on radio and radar propagation - conference
[AGARD-CP-97] c07 N72-21121
Project coordination and mission support for spacecraft operations noting data acquisition and transmission - conferences
[ESRO-SP-64] c11 N72-21291
Spacecraft control, satellite networks, and ground support in European space programs
[ESRO-SP-66] c11 N72-21296
Papers presented at conference on electronic density of states in solids and liquids
[NBS-SP-323] c26 N72-21702
Standardization of test procedures for determining stress corrosion cracking in high strength alloys and steels under various environments - conference
[AGARD-CP-98] c32 N72-21900
AGARD 1972 meetings, 1971 publications, and 1972 membership
[AGARD-BULL-72-1] c34 N72-21973

**CONICAL BODIES**
Numerical analysis of cone angle effects on penetration resistance in soils
[AD-735788] c14 N72-21460

**CONICAL FLOW**
Effect of swirl on conical diffuser performance and separation phenomena
[AD-735383] c12 N72-21321

**CONICAL SHELLS**
Buckling of stiffened and unstiffened cylindrical and conical shells
[AD-736044] c32 N72-21947

**CONSERVATION**
Utilization and conservation of earth resources
[NLL-M-22220-[5828.4F]] c13 N72-21350

**CONSTITUTIVE EQUATIONS**
Nonisothermal constitutive equations and thermodynamics for class of simple fluids with fading memory
[AD-735928] c06 N72-21114

**CONTAINERS**
Computerized planning and organization of container transportation
[AD-735436] c15 N72-21492

**CONTAMINANTS**
Techniques for studying crack morphology, contaminants, and electrochemistry in stress corrosion
c32 N72-21928

**CONTINUOUS RADIATION**
VHF bistatic CW auroral backscattering and influence of daytime, seasonal, and geomagnetic latitude
c13 N72-21128

**CONTROL**
Power control system for thermal nuclear reactor
[NASA-CASE-XLE-05799] c22 N72-21644

**CONTROL EQUIPMENT**
Characteristics of digital computer control and abort system for controlling test operations of rocket engines, structure tests, and wind tunnel tests
[NASA-TM-X-68040] c11 N72-21287
Interferometric prism and control system for precisely determining direction to remote light source
[NASA-CASE-ARC-10278-1] c14 N72-21434

**CONTROL MOMENT GYROSCOPES**
Development of rotation law for application to Skylab gyroscopes to avoid gimbal stop encounters
[NASA-CR-126140] c21 N72-21633

**CONTROL THEORY**
Convergence of discretization equations in numerical analysis of degenerate partial differential equations of stochastic control theory
[NASA-CR-126037] c19 N72-21568
Statistical methods for solving forecasting and control theory problems
[AD-735197] c19 N72-21578
Nonlinear filtering theory used for identification of parameters of linear differential equation model for optimal control applications
[AD-735787] c19 N72-21580

**CONTROL VALVES**
Dual stage check valve for cryogenic supply systems used in space flight environmental control system
[NASA-CASE-MSC-13587] c15 N72-21483

**CONTROLLABILITY**
Airborne simulator used to determine lateral-directional handling qualities for V/STOL aircraft in low speed maneuvering flight
[AD-735420] c02 N72-21014

**CONVERGENCE**
Convergence of discretization equations in numerical analysis of degenerate partial differential equations of stochastic control theory
[NASA-CR-126037] c19 N72-21568

**CONVERTERS**
Two fast gates using snap-off diodes for time-to-amplitude converter
[CEA-N-1491] c09 N72-21257

**CONVOLUTION INTEGRALS**
Derivation of convolution integral expression of optical density of states for k-conserving transitions between broadened levels in crystalline solids
c26 N72-21757

**COOLANTS**
Heat transfer and fluid flow characteristics of cylindrical enclosure having rotating and stationary walls in coolant throughflow
[AD-735492] c33 N72-21959

**COOLING SYSTEMS**
Jet blast deflector for controlling shipboard flight deck environment
[AD-735877] c33 N72-21963

**COORDINATES**
FORTRAN 4 program which computes and plots coordinates for two-dimensional orthogonal mesh in region between wall of flow channel
[NASA-TN-D-6766] c01 N72-20969

**COPLANARITY**
Resonators for diplexers in multiplexing network noting bandpass filters and coplanar waveguides
[ESRO-CR-46] c07 N72-21164

**COPOLYMERS**
Studying kinetics of degradation of polystyrenes and copolymers by dynamic thermogravimetry in vacuum
[AD-735278] c18 N72-21561

**COPPER**
Photoemission determination of energy distribution of joint density of states in copper
c26 N72-21724
Measurement of changes in reflectivity upon alloying of small amounts of Ag, Cu, and Fe into Au
c26 N72-21769

**COPPER ALLOYS**
In-process monitors, parellel-gap brazing of flexible copper circuit terminations, and copper alloy determination
[BDX-613-472] c09 N72-21256
Equilibrium surface segregation in copper-aluminum single crystal alloy using Auger electron spectroscopy
[NASA-TM-X-2543] c17 N72-21532
Magnetic ordering behavior in Cu-Ni alloys as function of Fe and Ni content
[BNL-16276] c17 N72-21540

**CORE FLOW**
Critical experiments for determining gas flow patterns of gas core reactor
[NASA-CR-120824] c22 N72-21645

**CORE STORAGE**
Memory device employing semiconductor and ferroelectric properties of single crystal barium titanate
[NASA-CASE-ERC-10307] c08 N72-21198
Aerospace computer memory technology and application of particular techniques to various system requirements
c08 N72-21218

**CORRECTION**
Mathematical models for computing gravity terrain corrections inside and outside circle of 5.26 km radius
c13 N72-21332

**CORROSION**
Atmospheric corrosion of metals and metal coatings
[JPRS-55554] c17 N72-21530
Analysis of chemical reactions and electrical exchanges causing pits in stainless steels exposed to an oxidizing chloride medium
[AEC-TR-7289] c17 N72-21543
Corrosion characteristics of seven zirconium alloys at 50 atm steam and 350 and 450 C
[AEC-TR-7287] c17 N72-21544

**CORROSION TESTS**
Stress corrosion tests of 7XXX series high strength aluminium alloys in laboratory environment
c14 N72-21903
Stress corrosion tests of titanium alloys and electron beam welded titanium alloys
c32 N72-21912

Precracked cantilever beam and long term beam exposure tests for determining stress corrosion of Al alloys in sea water
c17 N72-21919

**COSINE SERIES**
Service life of electromechanical device for generating sine/cosine functions
[NASA-CASE-LAR-10503-1] c09 N72-21248
Function generator for producing complex vibration mode patterns used to identify vibration mode data
[NASA-CASE-LAR-10310-1] c10 N72-21275

**COSMIC RAYS**
Ultrahigh energy cosmic ray attenuation due to hadron production
[RIFP-142] c29 N72-21830
Tabulated uncorrected and barometer-corrected cosmic ray neutron monitor data
[AECL-4060] c29 N72-21849
Daily diurnal and semidiurnal variation vectors for cosmic ray muon and neutron monitors
[AECL-4059] c29 N72-21850
Solar radiation, cosmic rays, satellite orbits, and upper atmosphere structure - bibliography
c34 N72-21975

**COSMOLOGY**
Cosmological models and counts of discrete extragalactic radio sources at various levels of flux density
[AD-734377] c29 N72-21853

**COST ANALYSIS**
Relative incidence and cost data for orientation-error accidents in regular Army UH-1 aircraft during fiscal year 1968
[AD-735457] c02 N72-21016
Development and application of single formula cost estimating relationships for determining costs of spacecraft platform components
[NASA-TM-X-68851] c31 N72-21894

**COST EFFECTIVENESS**
Cost/decision model for deferred procurement of Air Force depot maintenance capability with computerized application to F-15 inertial navigation system
[AD-735351] c02 N72-21029

**COST ESTIMATES**
Cost estimates for pintle, side mounted, and turret armament subsystems
[AD-735495] c34 N72-21988

**COST REDUCTION**
Technological improvements for reducing costs of solar cells and solar arrays
[NASA-TM-X-68035] c03 N72-21033
Potential cost reductions in operational ITOS weather satellite program by shuttle/tug availability
[NASA-CR-122398] c31 N72-21895

**COULOMB POTENTIAL**
Benormalization of light nuclei based on Coulomb potential differences
[NOTA-INTERNA-344-PT-1] c24 N72-21685

**COULOMETRY**
Coulometric measurement of micro-impurities of nitrogen oxide, sulfur dioxide, and ammonia in gases
[NLL-M-22138-[5828.4F]] c14 N72-21404

**CRABS**
Medical research abstracts on limulus visual system, electronic neuron model development, and auditory adaptation in horseshoe crab
[AD-734017] c04 N72-21073

**CRACK INITIATION**
Analysis of crack initiation and crack propagation in high strength Al alloys in different environments
c14 N72-21918

**CRACK PROPAGATION**
Premature hydrogen-induced failure in metal systems involving crack initiation, and stable and unstable crack growth
[NASA-TN-D-6691] c17 N72-21537
Nomenclature, stress-strain analysis, and crack propagation in metals
[AD-735700] c17 N72-21550
Effects of repassivation and crack velocity on stress corrosion cracking in alloys
c17 N72-21907
Threshold stress intensity values and crack propagation rates for stress corrosion of high strength steels in aqueous environment
c32 N72-21913
Laboratory equipment for testing stress corrosion of bolt loaded WOL specimens and monitoring crack growth
c32 N72-21914
Krafft model for determining susceptibility of Zn-Mg-Cu aluminum alloys to stress corrosion crack growth
c32 N72-21915
Acoustic emission technique for determining crack growth rate in high strength cantilever steel type specimens
c14 N72-21917
Analysis of crack initiation and crack propagation in high strength Al alloys in different environments
c14 N72-21918

**CRACKING [FRACTURING]**
Application of linear elastic fracture mechanics to developing stress corrosion cracking test standards
[NASA-TM-X-68303] c14 N72-21905
Cantilever bending tests for determining susceptibility of high strength alloys to stress corrosion cracking
c14 N72-21911
Microscopic characteristics of stress corrosion cracking in steel with high yield strength
c32 N72-21925
Strain rate experiments to evaluate resistance to stress corrosion cracking
c17 N72-21927
Techniques for studying crack morphology, contaminants, and electrochemistry in stress corrosion
c32 N72-21928

**CRASH INJURIES**
Use of shoulder harness in general aviation aircraft to prevent or minimize injury during crashes
[FAA-AM-72-3] c05 N72-21077
Effectiveness of restraint equipment in controlling head impact forces and body kinematics in enclosed aircraft areas
[FAA-AM-72-6] c05 N72-21078

**CRASH LANDING**
Aircraft accident report of DC 9 crash landing at Standiford Field, Louisville, Kentucky on 8 Sept. 1970
[PB-205250] c02 N72-21020

**CRASHES**
Battery powered aircraft crash locator transmitter
[NASA-CASE-MFS-16609] c14 N72-21431

**CREEP PROPERTIES**
High temperature, low stress creep in dispersion strengthened gold-alumina alloys
[AD-735710] c17 N72-21549

**CREEP STRENGTH**
Creep strength reduction in strain-aging refractory alloys by applying low-amplitude, high-frequency fatigue vibrations during creep tests
[NASA-CR-120891] c17 N72-21529

**CRITICAL EXPERIMENTS**
Critical experiments for determining gas flow patterns of gas core reactor
[NASA-CR-120824] c22 N72-21645

**CRITICAL PATH METHOD**
Simulation of turnaround operation of passenger aircraft using critical path method for improving aircraft/terminal utilization
c34 N72-21970

**CROSSED FIELD AMPLIFIERS**
Analysis of interactions of spiral electron cluster in crossed field traveling wave amplifier
[AD-735435] c09 N72-21260

**CRUCIFORM WINGS**
Aerodynamic characteristics of low aspect ratio, cruciform wing missile model with all-moveable wings and tails at supersonic speed
[NASA-TM-X-2531] c01 N72-20971

**CRYOGENIC EQUIPMENT**
Dual stage check valve for cryogenic supply systems used in space flight environmental control system
[NASA-CASE-MSC-13587] c15 N72-21483

**CRYOGENIC FLUID STORAGE**
Apparatus for aligning shadow shields and cryogenic storage tanks in outer space with the sun
[NASA-CASE-KSC-10622-1] c31 N72-21893

**CRYOGENICS**
Density of states from superconducting critical field measuremnts in indium and thallium
c26 N72-21782

**CRYSTAL FILTERS**
Determination of short pulse, radio frequency burnout properties of crystal diode mixers by application of pulses of controlled amplitude
[AD-735341] c09 N72-21266

**CRYSTAL GROWTH**
Electrodeposition method for producing crystalline material from dense gaseous medium
[NASA-CASE-NPO-10440] c15 N72-21466

**CRYSTAL LATTICES**
Lattice structure of Nb4N3 based on neutron diffraction analysis
c06 N72-21524
Solutions to band structure problems
c26 N72-21703
Application of chemical bond relationships to determine electronic density of states
c26 N72-21751

**CRYSTAL STRUCTURE**
Description of special case of Frenkel model to define crystal system with steeply falling off intermolecular interactions
c26 N72-21732
Development of numerical process for estimating enhancement factor on intensity of soft X ray emission in metals due to effect of core hole
c26 N72-21733
Measurement of absorption structure of lithium, beryllium, sodium, magnesium, and aluminum by photoabsorption process
c26 N72-21735
Soft X ray emission from alloys of aluminum with silver, copper, and zinc and comparison with conditions of simple metal alloyed with noble metal
c26 N72-21740
Application of chemical bond relationships to determine electronic density of states
c26 N72-21751
Atomic Structure of disordered alloys
c26 N72-21758
Preparation and crystal structure of KAgO and CsAgO
[NASA-TT-F-14192] c26 N72-21799
Influence of grain size on stress-strain relationship of tensile tested metals
[RAE-LIB-TRANS-1585] c32 N72-21934

**CRYSTALLINITY**
Derivation of convolution integral expression of optical density of states for k-conserving transitions between broadened levels in crystalline solids
c26 N72-21757
Localized electron density of states in narrow band and amorphous semiconductor crystalline solids
c26 N72-21763

**CRYSTALS**
Potential-independent feature of crystal band structure
[NASA-CR-126045] c26 N72-21791

**CURRENT DISTRIBUTION**
Power converters for supplying direct current from one voltage for another voltage for use
[NASA-CASE-XER-11046-2] c09 N72-21251

**CURVE FITTING**
Theoretical basis and application of computer-aided curve fit and analysis program
[AD-735946] c08 N72-21230

**CYBERNETICS**
Abstracts, bibliographies, and index on Soviet cybernetics
[AD-735651] c10 N72-21278

**CYCLOTRON RESONANCE**
Electron density of states and variation of infrared cyclotron resonance near conduction band edge of InSb
c26 N72-21755
Quantum cyclotron resonance spectrum of holes in degenerate valence bands of Ge analyzed using concept of critical point in magnetic joint density of states
c26 N72-21756

**CYLINDRICAL BODIES**
Heat transfer and fluid flow characteristics of cylindrical enclosure having rotating and stationary walls in coolant throughflow
[AD-735492] c33 N72-21959

**CYLINDRICAL SHELLS**
Sound transmission impedance in cyclindrical steel shells
[NLL-M-22125-[5828.4F]] c23 N72-21660
Buckling of stiffened and unstiffened cylindrical and conical shells
[AD-736044] c32 N72-21947

**CZECHOSLOVAKIA**
Gravity anomalies, seismic data, geomagnetism, and electrical conductivity of earth crust and upper mantle, and specific data for Czechoslovakia
c13 N72-21329
Earth tide observation stations in Czechoslovakian mines equipped with pendulums and inclinometers
c13 N72-21330
Gravity anomalies and earth crust structure in Bohemian Massif and West Carpathian regions of Czechoslovakia
c13 N72-21335
East-west and north-south polygons for measuring secular variations of gravity field in Czechoslovakia
c13 N72-21336
Deep seismic sounding data and natural seismic noise along international profile 6, and preliminary data along profiles 5 and 7, Czechoslovakia
c13 N72-21342
Short-period crustal movements in stationary Lisov traverse region, Czechoslovakia
c13 N72-21343
Analysis of Molodenskii mathematical model of earth figure, and application to test areas in Czechoslovakia
c13 N72-21345

## D

**D REGION**
Atmospheric model for echoes from weak D region disturbances
[AD-735514] c13 N72-21386

**DAMPING**
Stability and control moment gyro wobble damping of flexible, spinning space stations, using digital computer program
[NASA-CR-115525] c31 N72-21892

**DATA ACQUISITION**
Flight test program and data acquisition techniques for evaluation of Boeing 747 aircraft
c02 N72-20977
Characteristics of flight test instruments and techniques for overcoming limitation and sources of error
c02 N72-20984
Development of flight test procedures for use with advanced aircraft to determine cruise performance characteristics
c02 N72-20985

Comparison of flight test and wind tunnel data to determine areas of agreement when nonlinearities appear in aerodynamic coefficients of slender wing aircraft
c02 N72-20990
Determination of performance data and stability and control characteristics from aircraft performance under nonsteady flight conditions
c02 N72-20992
Development of techniques and equipment for determining moment of inertia of aircraft as applied to A-37 and P-1127 aircraft
[FTC-TIM-71-1001] c02 N72-21007
Data acquisition and transmission methods in relation to ESRO satellites, with emphasis on onboard computers
c07 N72-21295
Analysis of earthquake-explosion seismographic data based on results from seismic detection and earth noise investigations
[AD-735765] c13 N72-21399
Digital data acquisition and control for punching mass spectrometer data on IBM cards
[DP-1175] c14 N72-21443
Handbook describing ETR instrumentation to obtain data from missile and space flight tests
[AD-735263] c14 N72-21454
International survey of air pollution by aircraft engines and fuels
[AGARD-AR-40] c20 N72-21590

DATA MANAGEMENT
Design data on communications, data management, and onboard checkout subsystems, modular interfaces, and zero-gravity configuration for modular space station
[NASA-CR-123543] c31 N72-21882

DATA PROCESSING
Development of numerical process for extracting aerodynamic coefficients from flight test data
c19 N72-20991
Control, tracking, data acquisition, and processing relating to ESRO satellites
c11 N72-21292
Classification modes for multidisciplinary, high data rate requirements of ERTS sateilites
[NASA-CR-126024] c13 N72-21358
Numerical process for analyzing and summarizing fluid viscosity data over extended temperature ranges
[AD-735270] c15 N72-21499

DATA PROCESSING EQUIPMENT
Evaluation of pattern-matching speech bandwidth compression techniques used with voice data processor system
[AD-735308] c07 N72-21189
System security hardware, software, and procedural techniques in automated systems
[AD-735728] c08 N72-21234
Data base security and access limitation requirements for post 1975 automated TACC complex with tabulated security data
[AD-735729] c08 N72-21235
Security and access limitation problems in automated systems, TACC data baseline, and TACC user identification
[AD-735730] c08 N72-21236
Lists of data users, acronyms, and abbreviations in TACC data base
[AD-735731] c08 N72-21237
Growth capabilities and future automation of TACC data base security and limitation requirements
[AD-735732] c08 N72-21238
Utilization of militarized computers for target acquisition and surveillance signal processing applications
[AD-735327] c08 N72-21242

DATA RECORDERS
Design and characteristics of recording system for selective reprocessing and filtering of data to obtain optimum signal to noise ratios
[NASA-CASE-ERC-10112] c07 N72-21119

DATA RECORDING
Microphone array for detection and recording of infrasound
[KGO-TR-71-105] c14 N72-21445

DATA REDUCTION
Automatic data reduction aerial photographs of highway traffic
[PB-204810] c14 N72-21450
Data reduction for concentration measurements of solid particles in space
[NASA-TT-F-14188] c30 N72-21864

DATA TRANSMISSION
Analysis of information flow requirements between control tower operators and aircraft pilots and methods for displaying information
[DOT-TSC-FAA-71-18] c02 N72-21000
Development and characteristics of balloon interrogation package for use with Nimbus 4 satellite
[NASA-CR-122375] c14 N72-21410

DC 9 AIRCRAFT
Aircraft accident report of DC 9 crash landing at Standiford Field, Louisville, Kentucky on 8 Sept. 1970
[PB-205250] c02 N72-21020

DECIMETER WAVES
Determination of atmospheric absorption coefficient in shortwave region of decimeter range
[NLL-M-22050-[5828.4F]] c13 N72-21349

DECISION MAKING
Mathematical models for determining influence of weather forecasts on military operational decisions
[AD-735261] c20 N72-21602

DECOMPOSITION
Studying kinetics of degradation of polystyrenes and copolymers by dynamic thermogravimetry in vacuum
[AD-735278] c18 N72-21561

DECONTAMINATION
Using ethylene oxide as decontaminating agent for planetary quarantine
[NASA-CR-126034] c04 N72-21048

DEFECTS
Description of special case of Frenkel model to define crystal system with steeply falling off intermolecular interactions
c26 N72-21732

DEFENSE PROGRAM
Antiaircraft defense, including reliability and efficiency of radar data, tactics exercise, and recording equipment parameters
[AD-735425] c34 N72-21980

DEFLECTION
Nonlinear analysis of plates considering geometric and material effects, including large deflections
[AD-735937] c32 N72-21938

DEFORMATION
Strength and deformation properties of heat resistant alloys at high temperatures
[JPRS-55556] c17 N72-21531

DEGRADATION
Thermogravimetric analysis of thermal degradation of epoxide resins
[AD-735687] c18 N72-21564

DEMODULATION
Differential detection to demodulate data carrying pulses in radio relay systems
[AD-734255] c07 N72-21167

DENSITY MEASUREMENT
Fast response probe to measure density in variable density plane turbulent mixing layer between two different gas streams
[AD-735954] c14 N72-21459

DEOXYGENATION
Catalyst cartridge for use in carbon dioxide reduction system utilizing Bosch catalytic reaction
[NASA-CASE-LAR-10551-1] c06 N72-21099

DETECTION
Intruder detection system with signal transmission in response to transducer
[NASA-CASE-ARC-10097-2] c07 N72-21161
Remote detection of fog banks using lidar backscattering and infrared radiometry
[PB-204805] c14 N72-21451
Deployable pressurized cell structures for micrometeoroid penetration detector
[NASA-CASE-LAR-10295-1] c15 N72-21472

DETECTORS
Device for detection of combustion light preceding explosion in coal mine
[NASA-CASE-LAR-10739-1] c14 N72-21424
Very high resolution X ray spectrometry with cooled Si[Li] detectors and optoelectron preamplifier
[CEA-CONF-1840] c14 N72-21439
Application of position-sensitive semiconductor detectors to study heavy element nuclear reactions at intermediate energies
[MNC-3783-10] c14 N72-21442

DETONABLE GAS MIXTURES
Differential interferometer to study shock induced combustion by hypervelocity projectile in detonable gas mixture
[ISL-7/70] c14 N72-21446

DEW
Computer produced diurnal temperature and dew point tables and curves and their use in short-range weather forecasting
[AD-735276] c20 N72-21614

DIAMAGNETISM
Density of states and numbers of carriers determined from inversions of closed and open Fermi surface data derived from measurements of de Haas van Alpen effect
c26 N72-21795

DIAMONDS
Simplified technique and device for producing industrial grade synthetic diamonds
[NASA-CASE-MFS-20698-2] c15 N72-21481

DIAPHRAGMS [MECHANICS]
Equations of motion for mechanical property determination of sheet metals, using experimental data on diaphragms subjected to transversal shock
[AD-735437] c17 N72-21546

DIATOMIC MOLECULES
Reaction rate series, including research on reaction kinetics, diatomic molecules, and plasma physics
[AD-735510] c06 N72-21115

DICTIONARIES
Structure and use of thesaurus for automatic language translation
[NLL-RTS-6886] c34 N72-21965

DIELECTRICS
Process for making semiconductor devices with refractory dielectrics as diffusant masks
[NASA-CASE-XER-08476-2] c26 N72-21800

DIES
Stress corrosion behavior of die forgings made from Al-Zn-Mg-Cu alloys
c32 N72-21922

DIFFERENTIAL EQUATIONS
Nonlinear filtering theory used for identification of parameters of linear differential equation model for optimal control applications
[AD-735787] c19 N72-21580

DIFFERENTIAL INTERFEROMETRY
Differential interferometer to study shock induced combustion by hypervelocity projectile in detonable gas mixture
[ISL-7/70] c14 N72-21446

DIFFRACTION PATTERNS
Plasma diagnostic methods for measuring laser dispersion and interferometric phenomena
[AD-735480] c25 N72-21696

DIFFUSION THEORY
Calculation of density of electron levels for small particles using diffusion equation
c26 N72-21760

DIGITAL COMPUTERS
Application of digital computer techniques to aerospace systems and impact of new technologies
c08 N72-21212
Complementary software package for use of IHAS 4 computer
[AD-765681] c08 N72-21231
Characteristics of digital computer control and abort system for controlling test operations of rocket engines, structure tests, and wind tunnel tests
[NASA-TM-X-68040] c11 N72-21287

DIGITAL DATA
Digital thermometer with interchangeable temperature sensors
[AD-735662] c05 N72-21087

DIGITAL SYSTEMS
Survey of digital signal processing techniques for speech analysis
[AD-735919] c07 N72-21184
Digital signal processing algorithms useful in speech research
[AD-735921] c07 N72-21185
Collection of digital circuits with direct application in computer oriented systems
[NASA-SP-5949[01]] c08 N72-21209
Digital data acquisition and control for punching mass spectrometer data on IBM cards
[DP-1175] c14 N72-21443

DIGITALIS
Experimental and clinical studies in treating digitalis caused cardiac arrhythmias with sodium citrate using heart patients and dogs
[NASA-TT-F-14194] c04 N72-21045

DIODES
Temperature compensated light source with light emitting diode and circuitry for maintaining luminous power independent of temperature changes
[NASA-CASE-ARC-10467-1] c09 N72-21249
Two fast gates using snap-off diodes for time-to-amplitude converter
[CEA-N-1491] c09 N72-21257
Numerical analysis of electron flow in high current megavolt diodes with aid of computer program
[AD-735498] c09 N72-21262
Transducer and frequency discriminator circuit with four-terminal circulating diode bridge
[NASA-CASE-ARC-10364-1] c10 N72-21276
Pre- and post-irradiation electrical and optical properties of Ga As laser diodes
[AD-735939] c16 N72-21507
Gunn effect microwave diodes with RF shielding
[NASA-CASE-ERC-10119] c26 N72-21701
Microwave-oscillation in gallium arsenide diodes including Gunn effect
[REPT-1891] c26 N72-21801

DIOXIDES
Sulfur dioxide vs. particulate matter damage to electronic equipment from air pollution
[PB-204183] c09 N72-21259
Application of aerial photography for detecting effects of air pollution from sulfur dioxide on stands of timber
[PB-205279] c14 N72-21458

DIPLEXERS
Resonators for diplexers in multiplexing network noting bandpass filters and coplanar waveguides
[ESRO-CR-46] c07 N72-21164

DIRAC EQUATION
Methods of calculating surface energy, potential, and charge density near interface of transition metal
[NASA-CR-126043] c26 N72-21748
One-dimensional Dirac equation solved for Kronig-Penney model containing delta-potential impurity
c26 N72-21761

**DIRECT CURRENT**
Power converters for supplying direct current from one voltage for another voltage for use
[NASA-CASE-XER-11046-2] c09 N72-21251
Heterojunctions in dc electroluminescent flat panel display
[AD-735342] c09 N72-21267
**DIRECT POWER GENERATORS**
Power converters for supplying direct current from one voltage for another voltage for use
[NASA-CASE-XER-11046-2] c09 N72-21251
DC/DC converter for space application using linear analog to pulse width conversion in control loop to gain amplified regulated voltage
[ESRO-TN-105-ESTEC] c09 N72-21258
**DIRECTIONAL ANTENNAS**
Effect of external noise on angular resolution of highly directional radar antenna and radar range of ground station following heat shock of radome
[JPRS-55618] c07 N72-21156
Effects of external noise on angular resolution of highly directional radar antenna
c07 N72-21157
**DISLOCATIONS [MATERIALS]**
Generalized coherent potential theory of electronic structure of disordered systems
[NASA-CR-126044] c26 N72-21764
**DISORDERS**
Clinical analysis of hypokinesia caused changes in nervous system and effects of pharmocological preparations on hypokinesia disorders
[NASA-TT-F-14225] c04 N72-21046
Clinical treatment of vibration induced disorders in construction workers
[RAE-LIB-TRANS-1611] c04 N72-21051
**DISPENSERS**
Liquid aerosol dispenser with explosively driven piston to compress light gas to extremely high pressure
[NASA-CASE-MFS-20829] c12 N72-21310
Lyophilized spore dispenser for production of finely divided monoparticulate cloud of bacterial spores
[NASA-CASE-LAR-10544-1] c15 N72-21477
**DISPERSIONS**
Colloidal metallic dispersions and atomic absorption spectrometry
[NASA-TT-F-14232] c17 N72-21536
Analysis of high temperature plasma heating phenomena produced by ultrashort laser pulses
[AD-736483] c25 N72-21698
**DISPLACEMENT MEASUREMENT**
Experimental pitot probe displacement measurements in supersonic turbulent boundary layer
[NASA-TN-D-6759] c12 N72-21313
**DISPLAY DEVICES**
Evaluation program for frequency separated display principle in aircraft instrument panels
[AD-735915] c02 N72-21027
Guidance and control computer actuated display system techniques
c08 N72-21221
Heterojunctions in dc electroluminescent flat panel display
[AD-735342] c09 N72-21267
Comparative analysis of flat-panel display technology for fixed format applications including plasma display panels, light emitting diodes, electroluminescent films, liquid crystals, and digital-address flat cathode ray tubes
[AD-735329] c09 N72-21270
Preferred motion relationships for flight director display
[AD-735916] c14 N72-21456
**DISSOLVING**
Apparatus for mixing two or more liquids under zero gravity conditions
[NASA-CASE-LAR-10195-1] c15 N72-21488
**DISTANCE MEASURING EQUIPMENT**
Optical distance measuring device and field testing
[AD-735235] c13 N72-21385
Development of system for position location reporting and control of tactical aircraft using recursive navigation program
[AD-735262] c21 N72-21636
**DISTILLATION**
Carbon and gaseous isotope separation, diffusion in hydrogen-helium systems, and low temperature He-3 distillation
[MLM-1861] c06 N72-21110
**DISTRIBUTION FUNCTIONS**
Application of distribution functions and stochastic processes to determine production capability of series of work stations with variable service times
[AD-735363] c15 N72-21498
**DIURNAL VARIATIONS**
Synoptic models for studying summer monsoon and diurnal variations of meteorological parameters over Korat Plateau, Thailand
[AD-735283] c20 N72-21600
Daily diurnal and semidiurnal variation vectors for cosmic ray muon and neutron monitors
[AECL-4059] c29 N72-21850
**DIVING [UNDERWATER]**
Lactate-pyruvate and redox state responses of blood and tissue in chronic hypercapnia
[AD-734120] c04 N72-21057
Plasma creatine phosphokinase response to hypercapnia
[AD-734126] c04 N72-21058
Development and tests of sensitive methodologies for measuring sensory and motor impairment in hyperbaric environments
[AD-735117] c04 N72-21062
**DO-31 AIRCRAFT**
Flight tests of VTOL aircraft DO 31
c02 N72-20981
**DOCUMENTS**
AGARD 1972 meetings, 1971 publications, and 1972 membership
[AGARD-BULL-72-1] c34 N72-21973
**DOGS**
Experimental and clinical studies in treating digitalis caused cardiac arrhythmias with sodium citrate using heart patients and dogs
[NASA-TT-F-14194] c04 N72-21045
**DOPPLER EFFECT**
Doppler discrimination in high background noise of rotary winged aircraft
[AD-734118] c04 N72-21056
**DOPPLER NAVIGATION**
Navigation/guidance computer requirements for integrated navigation system using combination of outputs of inertial, Doppler, and loran equipment
c08 N72-21224
**DOPPLER RADAR**
Development of optical striations and Doppler spectrum broadening due to barium plasmas in ionosphere
c07 N72-21136
**DOUBLE PRECISION ARITHMETIC**
Data word length considerations for aerospace computer implementation to obtain required precision levels
c08 N72-21217
**DRAG CHUTES**
Development and characteristics of parachute fabric for aerodynamic decelerator using lightweight, variable solidity, knitted material
[NASA-CASE-LAR-10776-1] c02 N72-21004
**DRAG REDUCTION**
Torpedo drag reduction, using MHD boundary layer control and assuming nonzero electric field
[AD-735471] c12 N72-21320
**DRONE AIRCRAFT**
Analog and digital computer simulation analysis of performance and control of low-pressure-ratio turbojet engine for drone aircraft
[NASA-TM-X-2537] c28 N72-21817
**DURABILITY**
Wear resistance and durability of coatings from dry polyvinyl butyral paint SVL-21
[AD-735238] c18 N72-21562
**DUST**
Radiation measurements for determination of atmospheric dust particle concentration
[ISL-6/71] c13 N72-21373
**DYNAMIC CHARACTERISTICS**
Dynamic performance characteristics of large amplitude sinusoidal pressure generator used to calibrate pressure transducers
[NASA-CR-120874] c14 N72-21428
Dynamic system characterized by reuse of its resource after rehabilitation
[AD-735223] c34 N72-21984
**DYNAMIC MODELS**
Three dimensional seismic models of upper mantle using multicomponent gels to produce continuous variations in wave velocity
c13 N72-21339
**DYNAMIC PROGRAMMING**
Dynamic programming method for determining optimal repair and replacement policies for Naval aircraft
[AD-736094] c02 N72-21031
**DYNAMIC RESPONSE**
Indirect measurement of primate vestibular system function through analysis of vestibulo-ocular reflex response to various input stimuli
[AD-734545L] c04 N72-21065
**DYNAMIC STRUCTURAL ANALYSIS**
Application of mean square approximation system for determining structural vibrations and frequency variability
[NASA-CR-1961] c32 N72-21933
Finite elements for bars, shafts in torsion, Bernoulli-Euler beams, and Timoshenko beams for shock and vibration analysis
[AD-735923] c32 N72-21946

## E

**EARLY WARNING SYSTEMS**
Tests of remote automatic multipurpose station early warning system telemetry transmissions
[AD-736221] c07 N72-21195
**EARTH ATMOSPHERE**
Influence of solar flare on earth atmosphere
[NLL-M-22221-[5828.4F]] c13 N72-21351
Atmospheric transmittance near 5 microns and transmittance of CO laser radiation through synthetic atmospheres
[AD-736037] c16 N72-21512
**EARTH CRUST**
Gravity anomalies, seismic data, geomagnetism, and electrical conductivity of earth crust and upper mantle, and specific data for Czechoslovakia
c13 N72-21329
Earth tide observation stations in Czechoslovakian mines equipped with pendulums and inclinometers
c13 N72-21330
Gravity anomalies and earth crust structure in Bohemian Massif and West Carpathian regions of Czechoslovakia
c13 N72-21335
Computer programming for interpreting and processing seismic wave data related to earth crust and upper mantle
c13 N72-21341
Deep seismic sounding data and natural seismic noise along international profile 6, and preliminary data along profiles 5 and 7, Czechoslovakia
c13 N72-21342
Short-period crustal movements in stationary Lisov traverse region, Czechoslovakia
c13 N72-21343
Electrical conductivity of earth crust and upper mantle, and magnetotelluric field theory
c13 N72-21348
Electrical conductivity anomalies at crust-mantle discontinuity, Irkutsk region, USSR
[AD-734905] c13 N72-21376
**EARTH MANTLE**
Gravity anomalies, seismic data, geomagnetism, and electrical conductivity of earth crust and upper mantle, and specific data for Czechoslovakia
c13 N72-21329
Amplitude epicenter distance curves of P and S waves used to determine upper mantle structure of Southeastern Europe
c13 N72-21338
Three dimensional seismic models of upper mantle using multicomponent gels to produce continuous variations in wave velocity
c13 N72-21339
Computer programming for interpreting and processing seismic wave data related to earth crust and upper mantle
c13 N72-21341
Electrical conductivity of earth crust and upper mantle, and magnetotelluric field theory
c13 N72-21348
Electrical conductivity anomalies at crust-mantle discontinuity, Irkutsk region, USSR
[AD-734905] c13 N72-21376
**EARTH MOVEMENTS**
Short-period crustal movements in stationary Lisov traverse region, Czechoslovakia
c13 N72-21343
Computer programs for elastic wave propagation code to analyze ground motions from vertically oriented nuclear detonations
[NVO-1163-227] c13 N72-21371
**EARTH RESOURCES**
Role of solids thermal microwave noise in earth resources microwave radiometry
[RAC-0-3-R16] c07 N72-21163
Utilization and conservation of earth resources
[NLL-M-22220-[5828.4F]] c13 N72-21350
Dynamic system characterized by reuse of its resource after rehabilitation
[AD-735223] c34 N72-21984
**EARTH RESOURCES TECHNOLOGY SATELLITES**
Classification modes for multidisciplinary, high data rate requirements of ERTS satellites
[NASA-CR-126024] c13 N72-21358
**EARTHQUAKES**
Earthquake magnitudes, frequencies, and active regions in Europe
c13 N72-21337
Amplitude epicenter distance curves of P and S waves used to determine upper mantle structure of Southeastern Europe
c13 N72-21338
Tilt steps associated with local, regional and distant earthquakes
[RLO-2229-T-4-1] c13 N72-21367
**ECCENTRIC ORBITS**
Computer programming for determining moderate-to-highly eccentric satellite launch window considering satellite perturbations
[ESRO-SR-15] c30 N72-21874
**ECONOMIC ANALYSIS**
Economical satellite aided vehicle avoidance system for preventing midair collisions
[NASA-CASE-ERC-10419] c21 N72-21631
Computer program for economic analysis of managing high level radioactive wastes from reprocessing power reactor fuels
[ORNL-4633] c22 N72-21648

**ECONOMICS**
Thermal stability of molybdenum alloy, low alloy steel production and economics, and improving sound metal yield in cast and rolled products
[NLL-M-21286-[5828.4F]] c17 N72-21514

**EDUCATION**
French school for training navigation personnel
c11 N72-20993
Organization and operation of US Air Force Test Pilot School
c11 N72-20994
Procedures for training pilots in assessment of flight systems during attendance at Empire Test Pilot School, England
c11 N72-20995
Organization, operation, and curriculum of U.S. Navy Test Pilot School at Patuxent Naval Air Station, Maryland
c11 N72-20996

**EFFERENT NERVOUS SYSTEMS**
Development and tests of sensitive methodologies for measuring sensory and motor impairment in hyperbaric environments
[AD-735117] c04 N72-21062

**ELASTIC CYLINDERS**
Wave equations for determining scattering of sound from layered hollow elastic cylinders
[AD-735859] c23 N72-21670

**ELASTIC MEDIA**
Resonant frequency of linearly elastic, horizontally layered systems
[PB-205260] c13 N72-21396

**ELASTIC PLATES**
Structural stability analysis of elastic plates with finite element method based on expanded variational principles
c32 N72-21935

**ELASTIC PROPERTIES**
Application of linear elastic fracture mechanics to developing stress corrosion cracking test standards
[NASA-TM-X-68303] c14 N72-21905

**ELASTIC SHELLS**
Nonisothermal theory of elastic Cosserat surface and linear equations characterizing initial boundary value problems
[AD-735927] c32 N72-21937

**ELASTIC WAVES**
Elastic wave velocity and attenuation, gamma ray absorption, and thermal conductivity in rocks of interest to seismologists
c13 N72-21340
Computer programs for elastic wave propagation code to analyze ground motions from vertically oriented nuclear detonations
[NVO-1163-227] c13 N72-21371

**ELASTODYNAMICS**
Euler equations of motion for dynamics of gyroscope on elastic suspension
[SC-T-713086] c14 N72-21437

**ELASTOHYDRODYNAMICS**
Analysis of microasperity elastohydrodynamic lubrication of ball spinning in nonconforming groove and comparison with conventional conditions
[NASA-TN-D-6761] c15 N72-21469

**ELASTOMERS**
Elastomers for gaskets in pneumatic and hydraulic systems
[NASA-TN-D-6693] c18 N72-21556

**ELECTRIC BATTERIES**
High energy density sea water battery
[AD-735864] c03 N72-21038

**ELECTRIC BRIDGES**
Transient response analysis of single phase bridge rectifier circuit
[RAE-LIB-TRANS-1620] c10 N72-21273
Transducer and frequency discriminator circuit with four-terminal circulating diode bridge
[NASA-CASE-ARC-10364-1] c10 N72-21276
Application of self-balancing bridge for determining electrothermal and nonlinear behavior of electroexplosive device
[NASA-CR-125931] c11 N72-21281

**ELECTRIC CELLS**
Synthesis of thin silver sulfide films and measurement of electrical properties when used as cathode in solid electrolyte electrical cell
[NASA-TT-F-14196] c03 N72-21035

**ELECTRIC COILS**
Air-core and iron-core magnets and lenses with windings of finite thickness for accelerators
[BNL-TR-447] c11 N72-21303

**ELECTRIC CONDUCTORS**
Technique for attaching leads to electronic devices
[NASA-CASE-ERC-10424-2] c09 N72-21253
Electrically conducting solar cell doped metal oxide transparent coating for Aeros satellite equipotential surface
c18 N72-21558

**ELECTRIC CONTACTS**
Mechanically stable, thermally cyclicable point contacts for use in superconducting devices
[AD-735501] c14 N72-21453

**ELECTRIC CORONA**
Effect of double corona charging units on chemistry of materials used in electrostatic printing process
[AD-735369] c15 N72-21491

**ELECTRIC CURRENT**
Commutator for steering precisely controlled bidirectional currents through numerous loads by use of magnetic core shift registers
[NASA-CASE-NPO-10743] c08 N72-21199

**ELECTRIC FIELDS**
Apparatus for determining distance to lightning stroke by sensing magnetic and electric fields
[NASA-CASE-KSC-10698-1] c07 N72-21159
Torpedo drag reduction, using MHD boundary layer control and assuming nonzero electric field
[AD-735471] c12 N72-21320
Vector electric field measurements for F region
[AD-735099] c13 N72-21377
Magnetospheric processes, charged particles, and electric fields
[AD-735149] c13 N72-21388
Verification of Franz-Keldysh theory predictions as shown by interference of light and heavy hole contributions to electroreflectance spectrum of germanium
c26 N72-21754
Application of group theory to calculation of influence of electric field on electron paramagnetic resonance spectrum in ruby
[AD-735814] c26 N72-21807

**ELECTRIC FILTERS**
Multiloop RC active filter network with low parameter sensitivity and low amplifier gain
[NASA-CASE-ARC-10192] c09 N72-21245

**ELECTRIC MOTORS**
Electromagnetic field equations used for analysis of thrust and lateral forces in single-sided linear induction motors
[PB-205029] c09 N72-21265

**ELECTRIC NETWORKS**
Analysis of parameters of Riordan gyrator and application as simulated inductor in electric filter networks
[AD-736533] c09 N72-21271

**ELECTRIC POTENTIAL**
Plotter device for automatically drawing equipotential lines on sheet of resistance paper
[NASA-CASE-NPO-11134] c09 N72-21246

**ELECTRIC POWER SUPPLIES**
Design data on electrical power, environmental control/life support, propulsion, and guidance, navigation, and control subsystems for modular space station
[NASA-CR-123545] c31 N72-21881

**ELECTRIC TERMINALS**
In-process monitors, parellel-gap brazing of flexible copper circuit terminations, and copper alloy determination
[BDX-613-472] c09 N72-21256

**ELECTRICAL PROPERTIES**
Pre- and post-irradiation electrical and optical properties of Ga As laser diodes
[AD-735939] c16 N72-21507

**ELECTRICAL RESISTIVITY**
Electrical conductivity of earth crust and upper mantle, and magnetotelluric field theory
c13 N72-21348
Electrical conductivity anomalies at crust-mantle discontinuity, Irkutsk region, USSR
[AD-734905] c13 N72-21376
Differential calculus methods for determining conductivity of ionized gas and shock wave ionized plasmas
[FRNC-TH-75] c25 N72-21694
Electrical resistivity changes in gold-palladium alloys during hydrogen absorption
c26 N72-21786

**ELECTROCARDIOGRAPHY**
Portable equipment for detecting myocardial activity
[AD-735882] c05 N72-21084

**ELECTROCHEMISTRY**
Redox equilibria, thermodynamic properties of aqueous systems, and electrochemistry of aqueous systems and molten salts
[STU-68-261-U-208] c17 N72-21542
Techniques for studying crack morphology, contaminants, and electrochemistry in stress corrosion
c32 N72-21928

**ELECTRODEPOSITION**
Electrodeposition method for producing crystalline material from dense gaseous medium
[NASA-CASE-NPO-10440] c15 N72-21466

**ELECTRODES**
Microelectrodes for measuring pH gradients during stress corrosion of aluminum alloys and 1020 steel exposed to potassium chloride
c17 N72-21909

**ELECTROLUMINESCENCE**
Heterojunctions in dc electroluminescent flat panel display
[AD-735342] c09 N72-21267
Comparative analysis of flat-panel display technology for fixed format applications including plasma display panels, light emitting diodes, electroluminescent films, liquid crystals, and digital-address flat cathode ray tubes
[AD-735329] c09 N72-21270
Double injection and electroluminescence in doped anthracene crystals
[NLL-TRANS-2818-[9022.81]] c26 N72-21700
Transport properties of n-type alloys of GaP and ZnSe and their application to luminescent diodes
[NASA-CR-111997] c26 N72-21798

**ELECTROLYTES**
Improved electrolytes and electrodes for rechargeable, nonaqueous lithium batteries
[AD-735269] c03 N72-21036

**ELECTROMAGNETIC ABSORPTION**
Plasmon induced structure in optical interband absorption of free electrons
c26 N72-21718

**ELECTROMAGNETIC FIELDS**
Size and shape determination of conducting body causing electromagnetic field scattering
[AD-735287] c07 N72-21170
Electromagnetic field equations used for analysis of thrust and lateral forces in single-sided linear induction motors
[PB-205029] c09 N72-21265
Theory of external photoelectric effect in terms of quadratic response to incident electromagnetic field
c26 N72-21719

**ELECTROMAGNETIC NOISE**
Effects of external noise on angular resolution of highly directional radar antenna
c07 N72-21157
I/f noise distribution in semiconductors
[AD-735944] c26 N72-21805

**ELECTROMAGNETIC PULSES**
Mathematical models for analyzing electromagnetic pulses caused by nuclear weapon burst
[AD-735654] c07 N72-21183
Pulsed inductive plasma thruster
[AD-735721] c28 N72-21824

**ELECTROMAGNETIC PUMPS**
Design and fabrication of three-phase helical induction electromagnetic pump for use as boiler-feed pump of potassium Rankine cycle space electric power system
[NASA-CR-1949] c15 N72-21479

**ELECTROMAGNETIC SCATTERING**
Radio wave scattering from auroral ionization
[NASA-TM-X-68302] c07 N72-21131
Intensity of weak scattering from electron density irregularities in ionosphere
c07 N72-21134
Simulation and investigation of scattering mechanisms of radio aurora
c07 N72-21135
Multiple scattering effects of wave propagation in isotropic scattering media with solution of equations for coherent field and average intensity
[AD-735284] c07 N72-21169

**ELECTROMAGNETIC SHIELDING**
Electric and electromagnetic shielding with superconductors
[AD-735396] c26 N72-21806

**ELECTROMAGNETIC WAVE TRANSMISSION**
Effect of earths magnetic field on electromagnetic wave propagation through ionosphere and electron clouds
[AD-735265] c07 N72-21177

**ELECTROMECHANICAL DEVICES**
Service life of electromechanical device for generating sine/cosine functions
[NASA-CASE-LAR-10503-1] c09 N72-21248
Piezojunction electromechanical stress transducer
[NASA-CASE-ERC-10087-2] c14 N72-21430

**ELECTROMYOGRAPHY**
Electromyographic measurement of maximum voluntary muscle contraction endurance in chronic hyperventilators
[AD-734298] c04 N72-21072

**ELECTRON BEAM WELDING**
Stress corrosion tests of titanium alloys and electron beam welded titanium alloys
c32 N72-21912

**ELECTRON BEAMS**
Numerical analysis of electron flow in high current megavolt diodes with aid of computer program
[AD-735498] c09 N72-21262
Electron-positron storage rings noting QED, vector meson, and hadronic experiments
[NOTA-INTERNA-343] c24 N72-21686

**ELECTRON CLOUDS**
Effect of earths magnetic field on electromagnetic wave propagation through ionosphere and electron clouds
[AD-735265] c07 N72-21177

**ELECTRON DENSITY (CONCENTRATION)**
Intensity of weak scattering from electron density irregularities in ionosphere
c07 N72-21134
Radio signals from Explorer 22 for ionospheric electron content
c07 N72-21141

Measurement of peak electron density in barium clouds as function of time using multifrequency, high frequency radar observations
[AD-736040] c12 N72-21328
Linear combination of atomic orbitals interpolation method for calculating electron density of crystalline solid
c26 N72-21705
Infrared reflectivity of arsenic correlated with Fermi surface, magnetoreflection and optical reflectivity measurements
c18 N72-21707
Calculation of density of states in W, Ta, and Mo from corresponding energy band structure
c26 N72-21709
Nonrelativistic KKR calculations of Fermi surface properties of Cu, Ag, and Au at normal volume as function of pressure
c26 N72-21711
Parametrization techniques used for obtaining band structure for density of state calculations
c26 N72-21713
Calculating electron density of states using self-consistent orthogonalized plane wave model for compounds in isoelectronic sequences Si-AlP and Ge-GaAs-ZnSe
c26 N72-21714
Spin-polarized energy bands and electronic density of states in Eu-chalcogenides by augmented plane wave
c26 N72-21715
Theory of external photoelectric effect in terms of quadratic response to incident electromagnetic field
c26 N72-21719
Interpreting photoemission data from indium and aluminum in terms of density of states models
c26 N72-21721
Measurement of photoemission from thin films of europium and barium excited by vacuum ultraviolet and soft X ray radiation
c26 N72-21728
Numerical analysis and establishment of relationships for one-particle spectral function for conduction and core electrons in metals
c26 N72-21730
Numerical analysis of density of electron states in metals based on soft X ray transitions in solids
c26 N72-21731
Analysis of soft X ray spectra in light metals and development of theory for emission and absorption cancellation effects
c26 N72-21734
Application of soft X ray band spectra to determine similarities and differences between one electron spectrum and density of states
c26 N72-21737
Construction of density of states histogram for AuAl2 using augmented plane wave calculations of the valence and conduction bands
c26 N72-21738
Measurement of soft X ray emission spectrum of aluminum in gold aluminide alloy and comparison orbital state density at aluminum sites
c26 N72-21739
Concave grating spectrometer analysis of emission band for silicon and energy range of emission band for germanium
c26 N72-21744
Methods of calculating surface energy, potential, and charge density near interface of transition metal
[NASA-CR-126043] c26 N72-21748
Determination of density of states by analyzing current-voltage characteristics in field emission resonance tunneling in junctions
c26 N72-21749
Electron density of states and variation of infrared cyclotron resonance near conduction band edge of InSb
c26 N72-21755
Mathematical model of physical properties of density of states of noninteracting electrons moving in static potential of disordered systems
c26 N72-21759
Calculation of density of electron levels for small particles using diffusion equation
c26 N72-21760
Localized electron density of states in narrow band and amorphous semiconductor crystalline solids
c26 N72-21763
Photoelectric emission technique used to study density of states of three silver based alloys
c26 N72-21770
Calculation of one-electron density of state values from low temperature specific heat measurements
c26 N72-21771
Electron phonon coupling constant and bare electron density of states determined from elecctronic specific heat measurements
c26 N72-21772
Densities-of-states at Fermi level of Ti-Mo binary bcc alloys studied using low temperature specific heat augmented by magnetic permeability measurements
c26 N72-21775
Knight shifts and temperature dependence in electron density of states of transition metals
c26 N72-21776
Pauli paramagnetic susceptibility in metals and alloys with high electron density of state
c26 N72-21777

**ELECTRON DIFFUSION**
Pitch-angle diffusion of radiation belt electrons within plasmasphere
[AD-735934] c13 N72-21382

**ELECTRON DISTRIBUTION**
Electron density distribution and electron temperature measurements of F region by Millstone Hill Thomson scatter radar system during 1967
[AD-735727] c13 N72-21387

**ELECTRON EMISSION**
Measurement of effects produced by modulation of emission band of polycrystalline copper by alternating elastic strain
c26 N72-21736
Measurement of soft X ray emission spectrum of aluminum in gold aluminide alloy and comparison orbital state density at aluminum sites
c26 N72-21739
Concave grating spectrometer analysis of emission band for silicon and energy range of emission band for germanium
c26 N72-21744

**ELECTRON ENERGY**
Electron density distribution and electron temperature measurements of F region by Millstone Hill Thomson scatter radar system during 1967
[AD-735727] c13 N72-21387

**ELECTRON MICROSCOPES**
Electron microscope and method of making annular objective aperture
[NASA-CASE-ARC-10448-1] c14 N72-21421

**ELECTRON OPTICS**
Very high resolution X ray spectrometry with cooled Si[Li] detectors and optoelectron preamplifier
[CEA-CONF-1840] c14 N72-21439

**ELECTRON PARAMAGNETIC RESONANCE**
Application of group theory to calculation of influence of electric field on electron paramagnetic resonance spectrum in ruby
[AD-735814] c26 N72-21807

**ELECTRON PHONON INTERACTIONS**
Electron phonon coupling constant and bare electron density of states determined from elecctronic specific heat measurements
c26 N72-21772

**ELECTRON PRECIPITATION**
Dayside auroral, oval plasma density and conductivity enhancement due to magnetosheath electron precipitation
[NASA-CR-125929] c13 N72-21354
Characteristics of gallium arsenide using either cathode luminescence or trapped electrons
c26 N72-21802

**ELECTRON SCATTERING**
Positron and electron interactions in omega and phi meson regions at 990 MeV
[LAL-1256] c24 N72-21680
Radar reflection coefficients from one dimensional plasma and effects of electron-neutral and electron-ion collisions
[AD-735146] c25 N72-21697

**ELECTRON STATES**
Papers presented at conference on electronic density of states in solids and liquids
[NBS-SP-323] c26 N72-21702
Electronic band structures and densities of states for two intermetallic compounds having CsCl structure
c26 N72-21704
Linear combination of atomic orbitals interpolation method for calculating electron density of crystalline solid
c26 N72-21705
Calculation of density of states in W, Ta, and Mo from corresponding energy band structure
c26 N72-21709
Effects of compression on band structure and density of states of alkaline metals by augmented plane wave method
c26 N72-21712
Parametrization techniques used for obtaining band structure for density of state calculations
c26 N72-21713
Calculating electron density of states using self-consistent orthogonalized plane wave model for compounds in isoelectronic sequences Si-AlP and Ge-GaAs-ZnSe
c26 N72-21714
Spin-polarized energy bands and electronic density of states in Eu-chalcogenides by augmented plane wave
c26 N72-21715
Calculating density of states and optical properties of PbTe from augmented plane wave and linear combination of atomic orbital energy bands
c26 N72-21717
Plasmon induced structure in optical interband absorption of free electrons
c26 N72-21718
Theory of external photoelectric effect in terms of quadratic response to incident electromagnetic field
c26 N72-21719
Ultraviolet photoemission methods of determining density of valence and conduction states
[NASA-CR-126040] c26 N72-21720
Interpreting photoemission data from indium and aluminum in terms of density of states models
c26 N72-21721
Electron density of states for noble and transition metals by X ray photoelectron spectroscopy
c26 N72-21722
Energy distribution of optically excited electrons in Pd arising from direct interband transitions assuming constant momentum matrix elements
c26 N72-21723
Photoemission determination of energy distribution of joint density of states in copper
c26 N72-21724
Structure of d-band for Sc, Ti and Zr in 4 to 11.6 eV range by photoemission spectroscopy
c26 N72-21726
Numerical analysis and establishment of relationships for one-particle spectral function for conduction and core electrons in metals
c26 N72-21730
Numerical analysis of density of electron states in metals based on soft X ray transitions in solids
c26 N72-21731
Description of special case of Frenkel model to define crystal system with steeply falling off intermolecular interactions
c26 N72-21732
Development of numerical process for estimating enhancement factor on intensity of soft X ray emission in metals due to effect of core hole
c26 N72-21733
Numerical analysis of density conditions necessary for production of phase transition in solids
c26 N72-21750
Application of chemical bond relationships to determine electronic density of states
c26 N72-21751
Influence of generalized order-disorder on electron states for various types of binary intermetallic compounds
c26 N72-21762
T matrix theory of electron states in disordered systems used to determine spectral density for states of various symmetries in beta brass
c26 N72-21765
Nonlocalization of electron states at middle of continuous band for three dimensional model of tightly bound electrons with cellular disorder
c26 N72-21767
Direct and exchange core polarization contributions to spin susceptibility and relation of spin susceptibility and density of states for Mg and Cd
c26 N72-21779
Tunneling measurements of superconduction quasiparticle density of states of metals and semiconductors, and calculation of phonon spectra
c26 N72-21781
Density of states from superconducting critical field measuremnts in indium and thallium
c26 N72-21782
Temperature dependences of transport phenomena and electronic density of states at high temperatures for transition metals
c26 N72-21783
Metal-semiconductor barrier junction tunneling study of heavily doped n-type silicon density of states function
c26 N72-21784
Volume dependence of electron specific heat for superconducting gallium, aluminum, and thorium, for obtaining volume dependence of electronic density of states
c26 N72-21787
Density of states curves used to obtain thermodynamic information associated with allotropic phase transitions in bcc and fcc iron
c26 N72-21790
Band structure and density of states in zincblende-type semiconductors used to calculate nonlinear optical susceptibility responsible for second harmonic generation
c26 N72-21792
Density of states model applied to superconductivity problem in high transition temperature beta-tungsten superconductors
[NASA-CR-126047] c26 N72-21793
Summary and evaluation of trends in electronic density of states conference proceedings
c26 N72-21794
Density of states and numbers of carriers determined from inversions of closed and open Fermi surface data derived from measurements of de Haas van Alpen effect
c26 N72-21795
X ray photoelectron spectroscopic measurements of valence bands of AuAl2 and AuGa2, and gold 5d band dilemma
c26 N72-21796

Statistical errors in estimating density of states curves from energy band calculations, using aluminum data
c26 N72-21797

ELECTRON TRANSITIONS
Fluorescence, phosphorescence, and triplet quantum yields for organic molecules in rigid plastic media as function of temperature
[AD-735483] c06 N72-21113
Energy distribution of optically excited electrons in Pd arising from direct interband transitions assuming constant momentum matrix elements
c26 N72-21723

ELECTRON TUNNELING
Determination of density of states by analyzing current-voltage characteristics in field emission resonance tunneling in junctions
c26 N72-21749
Tunneling measurements of superconduction quasiparticle density of states of metals and semiconductors, and calculation of phonon spectra
c26 N72-21781
Metal-semiconductor barrier junction tunneling study of heavily doped n-type silicon density of states function
c26 N72-21784
Hydrogenation effects on electron tunneling characteristics of aluminum-oxide-palladium junctions
c26 N72-21789

ELECTRONIC COUNTERMEASURES
Analysis of secure communications capability at millimeter wavelengths and various types of weather conditions
[AD-735686] c07 N72-21168

ELECTRONIC EQUIPMENT
Technique for attaching leads to electronic devices
[NASA-CASE-ERC-10224-2] c09 N72-21253
Sulfur dioxide vs. particulate matter damage to electronic equipment from air pollution
[PB-204183] c09 N72-21259
Geomagnetism, satellite tracking, oceanography, hyperbolic navigation, and radio equipment research projects
[AD-735169] c21 N72-21639
Equipment mounting capability, safeguard against delamination of outer skin, and weight maintainance of shelter electrical equipment
[AD-735280] c32 N72-21940

ELECTRONS
Equilibrium surface segregation in copper-aluminum single crystal alloy using Auger electron spectroscopy
[NASA-TM-X-2543] c17 N72-21532
Behavior of electron wave functions near atomic nucleus and normalization screening theory in atomic photoeffect
[NYO-3829-75] c24 N72-21678
Muon pair production by electron-positron annihilation at energies up to 2.1 GeV
[NOTA-INTERNA-336] c24 N72-21689
Evaluation of excluded terms in multiple scattering series for electron in presence of several impurities
c26 N72-21766
Simultaneous IMP 6 observations of anisotropic packet of low-energy solar electron intensities and of type 3 solar radio burst
[NASA-CR-125932] c29 N72-21828
Analysis of solar flare particle measurements by Explorer 34 and 41 satellites
[NASA-CR-122389] c29 N72-21831
Access of solar protons and electrons to magnetotail and north polar cap
c29 N72-21837
Semiconductor particle telescope measurements of electron, proton, and alpha particle fluxes produced by Nov. 1969 west limb flare
c29 N72-21841
Explorer 34 measurements of solar protons, electrons, and alpha particles during extreme west hemisphere 1B solar flare of Nov. 18, 1968
c29 N72-21844
Interplanetary proton and electron data used to study association of particle data with type 3 solar radio bursts in dekametric band
c29 N72-21845
Ground and spacecraft observations of flare protons, alpha particles, and electrons
c29 N72-21848

ELECTROSTATIC WAVES
Investigation of high Mach number collisionless electrostatic shocks in plasmas
[IPPJ-119] c25 N72-21692

ELECTROSTATICS
Effect of double corona charging units on chemistry of materials used in electrostatic printing process
[AD-735369] c15 N72-21491

ELECTROTHERMAL ENGINES
Specification for performance, design, fabrication, test and quality assurance for electrothermal hydrazine thrustor
[NASA-CR-122377] c28 N72-21820

ELEMENTARY EXCITATIONS
Analysis of quasi-particle excitation in interacting many-body system using physical and mathematical methods
c26 N72-21729

ELEMENTARY PARTICLES
Analysis of quasi-particle excitation in interacting many-body system using physical and mathematical methods
c26 N72-21729

ENCAPSULATING
Suitability and reliability considerations in plastic encapsulated microcircuit applications
[AD-735500] c09 N72-21261

ENERGY
Papers presented at conference on electronic density of states in solids and liquids
[NBS-SP-323] c26 N72-21702

ENERGY BANDS
Linear combination of atomic orbitals interpolation method for calculating electron density of crystalline solid
c26 N72-21705
Using Ashcroft energy band model representation of measured Fermi surface for calculating optical properties of aluminum
c17 N72-21706
Calculation of density of states in W, Ta, and Mo from corresponding energy band structure
c26 N72-21709
Adjustment of calculated band structures for calcium by use of low temperature specific heat data
c26 N72-21710
Effects of compression on band structure and density of states of alkaline metals by augmented plane wave method
c26 N72-21712
Correlating electronic energy bands of tetragonal GeO2 with optical properties
c26 N72-21716
Calculating density of states and optical properties of PbTe from augmented plane wave and linear combination of atomic orbital energy bands
c26 N72-21717
Plasmon induced structure in optical interband absorption of free electrons
c26 N72-21718
Band structure of tungsten in energy region of 5d bands by photoelectric spectroscopy
c26 N72-21725
Structure of d-band for Sc, Ti and Zr in 4 to 11.6 eV range by photoemission spectroscopy
c26 N72-21726
Construction of density of states histogram for AuAl2 using augmented plane wave calculations of the valence and conduction bands
c26 N72-21738
Measurement of soft X ray emission spectrum of aluminum in gold aluminide alloy and comparison orbital state density at aluminum sites
c26 N72-21739
Soft X ray emission from alloys of aluminum with silver, copper, and zinc and comparison with conditions of simple metal alloyed with noble metal
c26 N72-21740
Measurement of soft X ray emission spectra for aluminum-magnesium alloys and comparison with spectra for pure metals
c26 N72-21741
Application of electroreflectance techniques to determine band population effects in indium antimonide
c26 N72-21752
Antiferromagnetic and paramagnetic states of half-filled narrow energy band investigated using t-matrix method
c26 N72-21768
Statistical errors in estimating density of states curves from energy band calculations, using aluminum data
c26 N72-21797

ENERGY DISTRIBUTION
Photoemission determination of energy distribution of joint density of states in copper
c26 N72-21724

ENERGY LEVELS
Application of soft X ray spectroscopy for determining electronic properties of titanium interstitial and intermetallic compounds
c26 N72-21743
Application of Compton scattering effect for measuring ground state electronic linear momentum distribution function for lithium and sodium
c26 N72-21746

ENERGY REQUIREMENTS
Effects of high altitude on cellular and energy metabolism in rats
[AD-734933] c04 N72-21064

ENGINE DESIGN
Numerical analysis of parameters in multistage gas turbine engines and components
[AD-736489] c28 N72-21827

ENGINE NOISE
Aircraft noise reduction by extinction with reversed phase sound in acoustic interference
[MBB-BB-55-71-O] c02 N72-21011

ENGINE TESTS
Development of techniques for evaluating performance of air breathing engines and measurement of significant operating parameters
[NASA-TM-X-68305] c28 N72-20983

ENVIRONMENT POLLUTION
Neutron activation analysis in environmental samples for determination of mercury pollution in Netherlands, noting use of chemical separation method
[IRI-133-71-17] c06 N72-21111
Analysis of Langley Research Center activities, geography, geology, and climate to determine sources of environmental pollution
[NASA-TM-X-67680] c11 N72-21285
Analysis of NASA-Ames Research Center activities, geography, geology, and climate to determine sources of environmental pollution
[NASA-TM-X-67669] c11 N72-21286
Impact of KSC operations on environment
[NASA-TM-X-67740] c11 N72-21289
Measurement and control of radioactive wastes in environment, soil, and water
[CONF-711113-3] c22 N72-21653
Effects of radioactive wastes from nuclear power generation on environment
[CONF-711113-2] c22 N72-21658

ENVIRONMENTAL CONTROL
Dual stage check valve for cryogenic supply systems used in space flight environmental control system
[NASA-CASE-MSC-13587] c15 N72-21483

ENVIRONMENTAL ENGINEERING
Ventilation systems for 33-foot diameter space station and 14-foot diameter modular space station
[NASA-CR-123593] c31 N72-21879

ENVIRONMENTAL TESTS
Environmental tests on high contrast laser-photochromic projection device, based on random access positioning
[AD-735281] c09 N72-21263
Environmental tests of hydrophones to obtain acceleration response measurements
[AD-735931] c13 N72-21391
Standardization of test procedures for determining stress corrosion cracking in high strength alloys and steels under various environments - conference
[AGARD-CP-98] c32 N72-21900
Stressing systems and environmental methods used by European Federation stress corrosion tests
c14 N72-21904
Analysis of crack initiation and crack propagation in high strength Al alloys in different environments
c14 N72-21918
Effects of heat treatment, size, specimen type, and test environment on two precipitation-hardened stainless steels during stress corrosion cracking tests
c17 N72-21923

ENZYMES
Plasma creatine phosphokinase response to hypercapnia
[AD-734126] c04 N72-21058

EPOXY RESINS
Measurement of static strength of lap bolted joints of fibrous composite material reinforced with boron film
[AD-735953] c15 N72-21493
Thermogravimetric analysis of thermal degradation of epoxide resins
[AD-735687] c18 N72-21564

EQUATIONS OF MOTION
Equations of motion for mechanical property determination of sheet metals, using experimental data on diaphragms subjected to transversal shock
[AD-735437] c17 N72-21546
Equations of motion for high frequency vibrations of piezoelectric crystal plates
[AD-735956] c26 N72-21803
Superposition principle for nonclassical forced motion of stationary and rotating beams with tip masses
[AD-735683] c32 N72-21939

EQUIPMENT SPECIFICATIONS
Flight tests performed following initial delivery or extensive repair and overhaul as performed by Canadian Armed Forces
c02 N72-20987
Specifications for magnetic proton spectrometer facility
[LA-4773-PT-1] c14 N72-21436
Simplified technique and device for producing industrial grade synthetic diamonds
[NASA-CASE-MFS-20698-2] c15 N72-21481
Specification for performance, design, fabrication, test and quality assurance for electrothermal hydrazine thrustor
[NASA-CR-122377] c28 N72-21820

EQUIPOTENTIALS
Electrically conducting solar cell doped metal oxide transparent coating for Aeros satellite equipotential surface
c18 N72-21558

**ERBIUM ALLOYS**
Specific heats of hexagonal close-packed erbium and thulium alloys measured in low temperature range between 1.3 and 4.2 K
c26 N72-21773

**EROSION**
Computerized simulation of relationships between barometric pressure, wind, waves, and currents on eastern shore of Lake Michigan
[AD-736224] c13 N72-21401
Computer codes for predicting effect of rocket exhaust plume impingement on sensitive space vehicle surfaces
[AD-735722] c33 N72-21962

**ERROR ANALYSIS**
Characteristics of flight test instruments and techniques for overcoming limitation and sources of error
c02 N72-20984
Statistical errors in estimating density of states curves from energy band calculations, using aluminum data
c26 N72-21797

**ESOPHAGUS**
Avalanche detector array for measuring low level plutonium in esophagus
[NYO-3246-TA-9] c14 N72-21440

**ESRO SATELLITES**
Project coordination and mission support for spacecraft operations noting data acquisition and transmission - conferences
[ESRO-SP-64] c11 N72-21291
Control, tracking, data acquisition, and processing relating to ESRO satellites
c11 N72-21292
Data acquisition and transmission methods in relation to ESRO satellites, with emphasis on onboard computers
c07 N72-21295
Passive and active spacecraft control noting data transmission and processing methods
c07 N72-21299

**ETHYLENE OXIDE**
Using ethylene oxide as decontaminating agent for planetary quarantine
[NASA-CR-126034] c04 N72-21048

**EULER EQUATIONS OF MOTION**
Euler equations of motion for dynamics of gyroscope on elastic suspension
[SC-T-713086] c14 N72-21437

**EULER-LAGRANGE EQUATION**
Computation of nearly circular satellite orbit perturbation due to geopotential harmonics
[ESRO-SR-13] c30 N72-21873

**EUROPE**
Earthquake magnitudes, frequencies, and active regions in Europe
c13 N72-21337
Amplitude epicenter distance curves of P and S waves used to determine upper mantle structure of Southeastern Europe
c13 N72-21338
Stressing systems and environmental methods used by European Federation stress corrosion tests
c14 N72-21904

**EUROPEAN SPACE PROGRAMS**
Project coordination and mission support for spacecraft operations noting data acquisition and transmission - conferences
[ESRO-SP-64] c11 N72-21291
Project and mission planning for European space programs
c11 N72-21293
Spacecraft control, satellite networks, and ground support in European space programs
[ESRO-SP-66] c11 N72-21296
Philosophy of network management and spacecraft control at ESOC
c11 N72-21298

**EUROPIUM COMPOUNDS**
Spin-polarized energy bands and electronic density of states in Eu-chalcogenides by augmented plane wave
c26 N72-21715

**EVAPORATION**
Apparatus which separately evaporates halides and mixes vapors
c15 N72-21521

**EVAPORATORS**
Boiling point depressor and absorbent in constant total pressure evaporation process with heat reuse by built-in engine
[PB-204619] c33 N72-21960

**EXCHANGING**
Pion exchange processes for elementary pion with transverse momentum cut-off
[NOTA-INTERNA-342] c24 N72-21687

**EXCITATION**
Vibrational relaxation for gaseous mixtures of CO and Ar using rapid heating and cooling rates
[DLR-FB-71-62] c12 N72-21315

**EXCITONS**
Discovery of antihelium 3 nuclei and excitons
[NLL-M-22112-[5828.4F]] c34 N72-21966

**EXHAUST DIFFUSERS**
Effect of swirl on conical diffuser performance and separation phenomena
[AD-735383] c12 N72-21321

**EXHAUST GASES**
Assessment of aircraft emission control technology and feasibility analysis of various control methods
[PB-204878] c02 N72-21017
Exhaust emissions tests of aircraft propulsion and auxiliary power gas turbine engines
[PB-204920] c02 N72-21018
Instruments for measuring air pollution emmitted by aircraft engines
[PB-204794] c20 N72-21592
Computer codes for predicting effect of rocket exhaust plume impingement on sensitive space vehicle surfaces
[AD-735722] c33 N72-21962

**EXOBIOLOGY**
Abstracts on space biology and medicine involved in cosmonaut training
[JPRS-55687] c04 N72-21043

**EXOSPHERE**
Spatial distribution of plasma in polar exosphere based on satellite data
c29 N72-21124

**EXPANDABLE STRUCTURES**
Technical feasibility of assembling large floating structures to provide temporary operational bases on ocean surface
[AD-735491] c11 N72-21306

**EXPERIMENTAL DESIGN**
Supporting technical data, and alternate experiments and spacecraft configurations for HEAO-C
[NASA-TM-X-64652-VOL-3] c11 N72-21284
Centaur sounding rocket Wadsworth spectrograph experimental design for auroral emission spectrophotographic recording
[ESRO-SM-80] c14 N72-21444

**EXPLORER 22 SATELLITE**
Radio signals from Explorer 22 for ionospheric electron content
c07 N72-21141

**EXPLORER 34 SATELLITE**
Analysis of solar flare particle measurements by Explorer 34 and 41 satellites
[NASA-CR-122389] c29 N72-21831
Satellite solar cosmic ray particle identifier using field effect transistor analog amplifier for Explorer 34 and 41 spacecraft
c29 N72-21832
Comparison of energetic storm protons and halo protons based on Explorer 34 data
c29 N72-21839
Explorer 34 measurements of low energy protons and alpha particles emitted during east limb solar flares
c29 N72-21842
Explorer 34 measurements of interplanetary solar protons and alpha particles during Oct. 26 through Nov. 1, 1968
c29 N72-21843

**EXPLORER 41 SATELLITE**
Analysis of solar flare particle measurements by Explorer 34 and 41 satellites
[NASA-CR-122389] c29 N72-21831
Satellite solar cosmic ray particle identifier using field effect transistor analog amplifier for Explorer 34 and 41 spacecraft
c29 N72-21832

**EXPLORER 43 SATELLITE**
Simultaneous IMP 6 observations of anisotropic packet of low-energy solar electron intensities and of type 3 solar radio burst
[NASA-CR-125932] c29 N72-21828

**EXPLOSIONS**
Crater classification and impact explosion origin of small lunar craters
[NASA-TT-F-14177] c30 N72-21867

**EXPLOSIVE DEVICES**
Application of self-balancing bridge for determining electrothermal and nonlinear behavior of electroexplosive device
[NASA-CR-125931] c11 N72-21281
Apparatus and method for quantitatively determining performance of linear explosives, mild detonating fuze, and flexible linear shaped charges
[NASA-CASE-LAR-10800-1] c33 N72-21955

**EXPOSURE**
Mechanical exposure interlock device for preventing film overexposure in oscilloscope camera
[NASA-CASE-LAR-10319-1] c14 N72-21423

**EXTERNAL STORES**
Mutual aerodynamic interference effects on flow field beneath aircraft with external stores examined by cross flow corrections method
[AD-735655] c01 N72-20974

**EXTINCTION**
Aircraft noise reduction by extinction with reversed phase sound in acoustic interference
[MBB-BB-55-71-O] c02 N72-21011

**EXTRAGALACTIC RADIO SOURCES**
Cosmological models and counts of discrete extragalactic radio sources at various levels of flux density
[AD-734377] c29 N72-21853

**EXTRATERRESTRIAL ENVIRONMENTS**
Extraterrestrial manufacturing in orbital workshops, noting applications to drugs, crystal growth, alloys, and optical glass
c31 N72-21897

**EXTRATERRESTRIAL RADIO WAVES**
Extensive 3.3 mm observations yielding disk average brightness temperatures for Mars, Jupiter, Saturn, and Uranus and variation search with time or phase angle
[AD-728204] c30 N72-21876

**EYE EXAMINATIONS**
Automated visual sensitivity tester for determining visual field sensitivity and blind spot size
[NASA-CASE-ARC-10329-1] c05 N72-21079

**EYE PROTECTION**
Ocular laser protective filter with narrowband absorption, luminous transmission, and optical density of 3.5
[AD-735799] c05 N72-21083


## F


**F REGION**
Intensity variations in satellite scintillations in F region
c07 N72-21138
High frequency backscatter observations of high latitude, field aligned irregularities in F region
c07 N72-21149
Vector electric field measurements for F region
[AD-735099] c13 N72-21377
Electron density distribution and electron temperature measurements of F region by Millstone Hill Thomson scatter radar system during 1967
[AD-735727] c13 N72-21387

**F-15 AIRCRAFT**
Cost/decision model for deferred procurement of Air Force depot maintenance capability with computerized application to F-15 inertial navigation system
[AD-735351] c02 N72-21029

**F-4 AIRCRAFT**
Dynamic programming method for determining optimal repair and replacement policies for Naval aircraft
[AD-736094] c02 N72-21031

**FABRICATION**
Processing and parameters for fabrication of controlled permeability porous beryllium billets from powder
[AD-736484] c17 N72-21554

**FACE CENTERED CUBIC LATTICES**
Measurement of low temperature specific heats of fcc Ru-Rh and Rh-Pd alloys
c26 N72-21774
Potential-independent feature of crystal band structure
[NASA-CR-126045] c26 N72-21791

**FAIL-SAFE SYSTEMS**
Computer system using adaptive voting to tolerate failure and operate in fail-operational, fail-safe manner
[NASA-CASE-MSC-13932-1] c08 N72-21206

**FAILURE ANALYSIS**
Premature hydrogen-induced failure in metal systems involving crack initiation, and stable and unstable crack growth
[NASA-TN-D-6691] c17 N72-21537
Failure of welded joints in Ti-Al-Sn alpha type alloys in CCl4 vapor
c32 N72-21929

**FAR INFRARED RADIATION**
Balloon measurements of far infrared background radiation
[NASA-CR-125936] c13 N72-21355
Spectroscopic research in far infrared region
[AD-735945] c23 N72-21667

**FAR ULTRAVIOLET RADIATION**
Measurement of photoemission from thin films of europium and barium excited by vacuum ultraviolet and soft X ray radiation
c26 N72-21728

**FAST TEST REACTORS**
Reactor shielding for fast test and liquid metal fast breeder reactors
[ORNL-TM-3639] c22 N72-21654

**FATIGUE [MATERIALS]**
Creep strength reduction in strain-aging refractory alloys by applying low-amplitude, high-frequency fatigue vibrations during creep tests
[NASA-CR-120891] c17 N72-21529

**FEED SYSTEMS**
Injector for introducing fluids into feed lines
[NASA-CASE-NPO-11377] c15 N72-21475

**FEEDBACK CONTROL**
Optimal control algorithms for on-line closed loop blood pressure regulation
[AD-735900] c05 N72-21088

Positive and negative feedback networks insensitive to variations in amplifier gains
[SCL-DR-710094] c10 N72-21277

**FEEDING [SUPPLYING]**
Automatic pair feeding device for controlled feeding of test animals
[NASA-CASE-ARC-10302-1] c04 N72-21052

**FERMI LIQUIDS**
Papers presented at conference on electronic density of states in solids and liquids
[NBS-SP-323] c26 N72-21702
Analysis of quasi-particle excitation in interacting many-body system using physical and mathematical methods
c26 N72-21729

**FERMI SURFACES**
Using Ashcroft energy band model representation of measured Fermi surface for calculating optical properties of aluminum
c17 N72-21706
Infrared reflectivity of arsenic correlated with Fermi surface, magnetoreflection and optical reflectivity measurements
c18 N72-21707
Adjustment of calculated band structures for calcium by use of low temperature specific heat data
c26 N72-21710
Nonrelativistic KKR calculations of Fermi surface properties of Cu, Ag, and Au at normal volume as function of pressure
c26 N72-21711
Direct and exchange core polarization contributions to spin susceptibility and relation of spin susceptibility and density of states for Mg and Cd
c26 N72-21779
Fermi surface topology information on indium cadmium alloy system from superconductivity measurements
c26 N72-21788
Density of states and numbers of carriers determined from inversions of closed and open Fermi surface data derived from measurements of de Haas van Alpen effect
c26 N72-21795

**FERROMAGNETISM**
Calculating band structure of ferromagnetic iron by variational method using tight binding functions and orthogonalized plane waves
c23 N72-21708

**FIELD EFFECT TRANSISTORS**
Improved detectivity of pyroelectric detectors through use of new materials and improved field effect transistors
[NASA-CR-122382] c14 N72-21427
Fabrication and experimental analysis of metal insulator semiconductor devices for radiation vulnerability studies
[AD-735947] c26 N72-21804

**FIGHTER AIRCRAFT**
Application of statistical methods for establishing positive maneuver loads design criteria for fighter aircraft
[AD-735472] c02 N72-21015

**FILM BOILING**
Numerical analysis of vaporization time of drops in film boiling with consideration of diffusive and radiative effects
[NASA-TM-X-68037] c33 N72-21953

**FINE STRUCTURE**
Vacuum ultraviolet multiplets for ionized carbon and oxygen, and absolute emission cross sections
[NASA-TM-X-65864] c24 N72-21676

**FINITE DIFFERENCE THEORY**
Implicit finite difference scheme for numerical integration of equations governing hypersonic slipflow-boundary layers
[DLR-FB-71-97] c12 N72-21317
Alternating direction implicit finite difference method for studying theta pinch dynamics and plasma control
[UCRL-51103] c25 N72-21695

**FINITE ELEMENT METHOD**
Finite element mathematical models for equations of motion of flexing head of BQS-6 transducer
[AD-735459] c16 N72-21505
Small displacement/small strain finite element technique for gravity flow initiation analysis
[PB-205504] c30 N72-21877
Structural stability analysis of elastic plates with finite element method based on expanded variational principles
c32 N72-21935
Computer program based on finite element method for analysis of stiffened plates under combined in-plane and lateral loads
[AD-735936] c32 N72-21936
Finite element method for current shell analysis capability
[AD-735726] c32 N72-21941
Finite elements for bars, shafts in torsion, Bernoulli-Euler beams, and Timoshenko beams for shock and vibration analysis
[AD-735923] c32 N72-21946

**FINS**
Aerodynamic wind tunnel stability tests for determining fin deflection angle and vertical position of frustrum of space shuttle at high angles of attack
[NASA-CR-120040] c31 N72-21889

**FIRE CONTROL**
Digital computers for navigation and guidance systems and fire control systems in tactical aircraft
c08 N72-21227

**FLAPS [CONTROL SURFACES]**
Numerical analysis of aircraft noise created by externally blown flaps on STOL aircraft and methods for noise reduction
[NASA-TM-X-68047] c02 N72-21001

**FLASH LAMPS**
Prototype alkali vapor flash lamps
[AD-735951] c23 N72-21666

**FLAT LAYERS**
Resonant frequency of linearly elastic, horizontally layered systems
[PB-205260] c13 N72-21396

**FLIGHT ALTITUDE**
Terminal guidance system for guiding aircraft into preselected altitude and/or heading at terminal point
[NASA-CASE-FRC-10049-1] c21 N72-21632

**FLIGHT CHARACTERISTICS**
Airborne simulator used to determine lateral-directional handling qualities for V/STOL aircraft in low speed maneuvering flight
[AD-735420] c02 N72-21014

**FLIGHT CONTROL**
Development of direct side force control on aircraft during flight and application to improved bombing accuracy
[AD-735294] c02 N72-21030
Application of programmed pilotage techniques to vary aerodynamic parameters during flight for enhancement of level flight speed characteristics of VTOL aircraft
[AD-736537] c02 N72-21032

**FLIGHT CREWS**
Anthropometric requirements for entrance into naval flight training program
[AD-735101] c04 N72-21067

**FLIGHT INSTRUMENTS**
Evaluation program for frequency separated display principle in aircraft instrument panels
[AD-735915] c02 N72-21027
Centaur sounding rocket Wadsworth spectrograph experimental design for auroral emission spectrophotographic recording
[ESRO-SM-80] c14 N72-21444

**FLIGHT OPTIMIZATION**
Application of programmed pilotage techniques to vary aerodynamic parameters during flight for enhancement of level flight speed characteristics of VTOL aircraft
[AD-736537] c02 N72-21032

**FLIGHT PATHS**
Simulation and optimization on combative and cooperative two vehicles flight paths
[AD-734755] c08 N72-21229
Programmers manual for generalized digital computer program written in FORTRAN for simulation and/or optimization of arbitrarily defined vehicle flight paths
[AD-735293] c08 N72-21239

**FLIGHT PLANS**
Planning and management of air traffic control system based on random sample of flight plans filed at flight service stations during calendar year 1970
[AD-735970] c21 N72-21641

**FLIGHT SAFETY**
Numerical analysis of aircraft collision probability due to reduced separation intervals and arbitrary flight paths
[DOT-TSC-FAA-71-27] c02 N72-20997
Design and development of collision avoidance system for use with general aviation aircraft
[NASA-CR-112023] c21 N72-21625
Evaluation of FAA advanced flow control procedures for air traffic control based on digital simulation of New York City air traffic
[DOT-TSC-FAA-72-8] c21 N72-21630
Planning and management of air traffic control system based on random sample of flight plans filed at flight service stations during calendar year 1970
[AD-735970] c21 N72-21641
Analysis of air traffic control procedures employed on air routes over North Atlantic Ocean
[PB-204862] c21 N72-21642

**FLIGHT TEST VEHICLES**
Proceedings of conference on aircraft flight test procedures, data acquisition, data processing, and correlation with wind tunnel test results
[AGARD-CP-85] c02 N72-20976
Flight test procedures for determining stall and spin characteristics of high performance aircraft
c02 N72-20979

**FLIGHT TESTS**
Proceedings of conference on aircraft flight test procedures, data acquisition, data processing, and correlation with wind tunnel test results
[AGARD-CP-85] c02 N72-20976
Flight test program and data acquisition techniques for evaluation of Boeing 747 aircraft
c02 N72-20977
Mathematical models for determining flight performance of Concorde aircraft
c02 N72-20978
Stability and control flight test procedures for V/STOL aircraft in general and specific application to F-1127 and Harrier aircraft
c02 N72-20980
Flight tests of VTOL aircraft DO 31
c02 N72-20981
Characteristics of flight test instruments and techniques for overcoming limitation and sources of error
c02 N72-20984
Development of flight test procedures for use with advanced aircraft to determine cruise performance characteristics
c02 N72-20985
Techniques and procedures for conducting flight tests of lifting body type aircraft during transonic and supersonic flight conditions
[NASA-TM-X-68306] c02 N72-20986
Flight tests performed following initial delivery or extensive repair and overhaul as performed by Canadian Armed Forces
c02 N72-20987
Flight test procedures for determining turning capability of military aircraft
c02 N72-20989
Comparison of flight test and wind tunnel data to determine areas of agreement when nonlinearities appear in aerodynamic coefficients of slender wing aircraft
c02 N72-20990
Development of numerical process for extracting aerodynamic coefficients from flight test data
c19 N72-20991
Determination of performance data and stability and control characteristics from aircraft performance under nonsteady flight conditions
c02 N72-20992
Organization and operation of US Air Force Test Pilot School
c11 N72-20994
Procedures for training pilots in assessment of flight systems during attendance at Empire Test Pilot School, England
c11 N72-20995
Organization, operation, and curriculum of U.S. Navy Test Pilot School at Patuxent Naval Air Station, Maryland
c11 N72-20996
Handbook describing ETR instrumentation to obtain data from missile and space flight tests
[AD-735263] c14 N72-21454

**FLOATING**
Inflatability and flotation of one man life raft after puncture to main wall
[NASA-CASE-LAR-10241-1] c05 N72-21076

**FLOATS**
Technical feasibility of assembling large floating structures to provide temporary operational bases on ocean surface
[AD-735491] c11 N72-21306

**FLOW DISTRIBUTION**
Mutual aerodynamic interference effects on flow field beneath aircraft with external stores examined by cross flow corrections method
[AD-735655] c01 N72-20974
Numerical analysis and theoretical discussion of effects of high velocity liquid impact and cavitation flow
c12 N72-21314
Instrument for measuring magnitude and direction of flow velocity in flow field
[NASA-CASE-LAR-10855-1] c14 N72-21417
Critical experiments for determining gas flow patterns of gas core reactor
[NASA-CR-120824] c22 N72-21645

**FLOW EQUATIONS**
Numerical analysis of one dimensional momentum flux and comparison with experimental value for range of two phase flow conditions
[NASA-TM-X-68038] c12 N72-21311

**FLOW MEASUREMENT**
Numerical conversion of three dimensional stationary detached flow to two dimensional nonstationary detached flow about flat bodies
[AD-735604] c12 N72-21322

**FLOW THEORY**
Numerical analysis of one dimensional momentum flux and comparison with experimental value for range of two phase flow conditions
[NASA-TM-X-68038] c12 N72-21311

**FLOW VELOCITY**
Instrument for measuring magnitude and direction of flow velocity in flow field
[NASA-CASE-LAR-10855-1] c14 N72-21417

**FLOW VISUALIZATION**
Optimization of fluidic temperature control for space suits based on flow visualization
[NASA-CR-115511] c14 N72-21426

**FLUID FILMS**
Journal bearing sectors for lubricant films
[NASA-CASE-LEW-11076-1] c15 N72-21473
**FLUID FILTERS**
Use of gas and liquid filters to sterilize spacecraft
[NASA-CR-126035] c04 N72-21047
**FLUID FLOW**
Nonisothermal constitutive equations and thermodynamics for class of simple fluids with fading memory
[AD-735928] c06 N72-21114
Mathematical flow models and mass transfer
[NLL-RTS-6990] c12 N72-21308
Injector for introducing fluids into feed lines
[NASA-CASE-NPO-11377] c15 N72-21475
Heat transfer and fluid flow characteristics of cylindrical enclosure having rotating and stationary walls in coolant throughflow
[AD-735492] c33 N72-21959
**FLUIDIC CIRCUITS**
Comparing transition of capacitance predicted by acoustic theory and that measured in lumped parameter fluid circuit
[AD-735704] c12 N72-21325
**FLUIDICS**
Comparing transition of capacitance predicted by acoustic theory and that measured in lumped parameter fluid circuit
[AD-735704] c12 N72-21325
**FLUORIDES**
Magnetic hyperfine structure and Mossbauer effect in rubidium and potassium fluorides
[BNL-16326] c06 N72-21107
**FLUORINE**
Reaction of simulated lunar dust with fluorine to determine feasibility of oxygen generation
[NASA-TM-X-2533] c06 N72-21098
**FLUORINE COMPOUNDS**
Valve sealing performance in fluorinated oxidizers
[AD-735286] c15 N72-21494
Ground and vehicle systems for liquid fluorine space shuttle
[AD-735290] c27 N72-21812
**FLUORO COMPOUNDS**
Oxygen difluoride in synthesis of fluoropolymers
[NASA-CASE-NPO-12061-1] c06 N72-21100
**FLUTTER**
Aerodynamic control system for controlling flutter
[NASA-CASE-LAR-10682-1] c02 N72-21009
**FLUX DENSITY**
Cosmological models and counts of discrete extragalactic radio sources at various levels of flux density
[AD-734377] c29 N72-21853
**FLYING PERSONNEL**
French school for training navigation personnel
c11 N72-20993
**FOAMS**
Polyimide foams produced in presence of alkanolamine or siloxane-glycol polymer
[NASA-CASE-ARC-10464-1] c06 N72-21102
**FOG**
Remote detection of fog banks using lidar backscattering and infrared radiometry
[PB-204805] c14 N72-21451
**FOLDING STRUCTURES**
Blade stress analysis, wind tunnel models, and test procedures for investigating conversion process of folding tilt-rotor aircraft - Vol. 4
[AD-735733] c02 N72-21028
**FORECASTING**
Statistical methods for solving forecasting and control theory problems
[AD-735197] c19 N72-21578
**FORESTS**
Application of aerial photography for detecting effects of air pollution from sulfur dioxide on stands of timber
[PB-205279] c14 N72-21458
**FORGING**
Stress corrosion behavior of die forgings made from Al-Zn-Mg-Cu alloys
c32 N72-21922
**FORTRAN**
MIMUSA, matrix iteration method of unfolding spectra, using FORTRAN 4 subroutine
[RD/B/N-1962-PT-1] c08 N72-21228
Programmers manual for generalized digital computer program written in FORTRAN for simulation and/or optimization of arbitrarily defined vehicle flight paths
[AD-735293] c08 N72-21239
**FORWARD SCATTERING**
Forward and backscattering caused by wave interaction with auroral ionization and theories of irregularity production
c07 N72-21126
**FOURIER TRANSFORMATION**
Complex spatial filters in coherent optical correlators recorded by Fourier transform method
[NASA-TN-D-6581] c23 N72-21661
**FRACTURE MECHANICS**
Notch sensitivity of various steels and alloys used in reactor materials after irradiation
[AD-735872] c22 N72-21659
Application of linear elastic fracture mechanics to developing stress corrosion cracking test standards
[NASA-TM-X-68303] c14 N72-21905
Determination of stress corrosion cracking parameters for 300M steel
c32 N72-21906
Stress corrosion index for measuring conjoint action between stress and corrosion in stress corrosion of Al alloys
c32 N72-21908
Ultrahigh vacuum for determining effects of hydrogen on fatigue and fracture properties of Ni 200
c14 N72-21916
**FRANCE**
French school for training navigation personnel
c11 N72-20993
**FREE ELECTRONS**
Plasmon induced structure in optical interband absorption of free electrons
c26 N72-21718
**FREQUENCY CONTROL**
Requirements for high frequency aircraft antennas
[AD-735886] c07 N72-21176
**FREQUENCY DIVISION MULTIPLEXING**
System for monitoring condition-responsive devices by using frequency division multiplex technique
[NASA-CASE-KSC-10521-1] c07 N72-21160
**FREQUENCY MEASUREMENT**
Power spectral densities, Doppler shifts, and phase fluctuations of frequency distortion in auroral HF propagation
c07 N72-21143
**FREQUENCY SHIFT KEYING**
Bit detection methods and detectors for FSK and PSK modulated data
c07 N72-21294
**FRICTION**
Determination of platform fluctuation in inertial navigation system due to dry friction in accelerometer
[AD-734920] c21 N72-21643
**FRICTION FACTOR**
Determination of platform fluctuation in inertial navigation system due to dry friction in accelerometer
[AD-734920] c21 N72-21643
**FRICTION MEASUREMENT**
Development of methods for determining coefficient of friction and extent of stick-slip friction of magnetic recording tapes
[NASA-CR-125930] c07 N72-21154
**FRICTION REDUCTION**
Analysis of microasperity elastohydrodynamic lubrication of ball spinning in nonconforming groove and comparison with conventional conditions
[NASA-TN-D-6761] c15 N72-21469
**FRONTS [METEOROLOGY]**
Comparison of simultaneous raindrop and radar pulse integrator observations for rain intensity associated with cold front passage
[NLL-M-22067-[5828.4F]] c20 N72-21588
**FUEL CONTAMINATION**
Fungicidal potency of antiicing additive for jet fuel
[AD-735451] c04 N72-21068
**FUEL PUMPS**
Design, development, and characteristics of variable delivery, positive displacement fuel pump for use with J-85 turbine engine fuel system
[AD-735259] c15 N72-21496
**FUEL SYSTEMS**
Life tests for SNAP 23A fueled prototype mockup system
[WANL-4219-1] c22 N72-21656
**FUEL TANKS**
Pressure tight seal for superalloy used in hypersonic aircraft fuel tank joints
[NASA-CASE-LAR-10170-1] c15 N72-21471
**FUELS**
Triethyl aluminum as fuel or fuel additive for heat addition by external combustion hypersonic vehicle
[DLR-MITT-71-26] c28 N72-21822
**FUNCTION GENERATORS**
Service life of electromechanical device for generating sine/cosine functions
[NASA-CASE-LAR-10503-1] c09 N72-21248
Function generator for producing complex vibration mode patterns used to identify vibration mode data
[NASA-CASE-LAR-10310-1] c10 N72-21275
**FUNGICIDES**
Fungicidal potency of antiicing additive for jet fuel
[AD-735451] c04 N72-21068
**FUSION WELDING**
Documenting welding skills acquired during Saturn S-2 Program
[NASA-CR-123487] c15 N72-21468

## G

**GALLIUM ALLOYS**
Transport properties of n-type alloys of GaP and ZnSe and their application to luminescent diodes
[NASA-CR-111997] c26 N72-21798
**GALLIUM ARSENIDE LASERS**
Pre- and post-irradiation electrical and optical properties of Ga As laser diodes
[AD-735939] c16 N72-21507
**GALLIUM ARSENIDES**
Determination of short pulse, radio frequency burnout properties of crystal diode mixers by application of pulses of controlled amplitude
[AD-735341] c09 N72-21266
Microwave-oscillation in gallium arsenide diodes including Gunn effect
[REPT-1891] c26 N72-21801
Characteristics of gallium arsenide using either cathode luminescence or trapped electrons
c26 N72-21802
**GAMMA RAYS**
Elastic wave velocity and attenuation, gamma ray absorption, and thermal conductivity in rocks of interest to seismologists
c13 N72-21340
High energy gamma photon activation and high resolution gamma ray spectrometry for standard and Apollo 12 rock analysis
[AERE-R-6910] c13 N72-21368
Gamma ray assay for verifying U-235 content in fuel pins
[ANL-7839] c22 N72-21657
Physical processes involved in transformation of gamma ray energy into optical information on photographic emulsions
[NP-19129] c24 N72-21682
**GAS ANALYSIS**
Development and characteristics of injection system for use with gas chromatograph
[NASA-CASE-ARC-10344-1] c14 N72-21433
**GAS CHROMATOGRAPHY**
Development and characteristics of injection system for use with gas chromatograph
[NASA-CASE-ARC-10344-1] c14 N72-21433
**GAS COOLED REACTORS**
Computer program for analysis of transient afterheat temperature and pressure response of gas cooled nuclear reactor
[NASA-CR-120825] c22 N72-21647
**GAS DENSITY**
Electrodeposition method for producing crystalline material from dense gaseous medium
[NASA-CASE-NPO-10440] c15 N72-21466
**GAS DETECTORS**
Fast response miniature carbon dioxide detector with no moving parts for measuring concentration in any atmosphere
[NASA-CASE-MSC-13332-1] c14 N72-21408
**GAS DISCHARGE TUBES**
Gain measurements in amplifier discharge tube under ac excited and pulse discharge conditions
[AD-735334] c16 N72-21511
**GAS FLOW**
Fast response probe to measure density in variable density plane turbulent mixing layer between two different gas streams
[AD-735954] c14 N72-21459
Gas heat transfer in heat exchangers
[NLL-M-22137-[5828.4F]] c33 N72-21951
**GAS GENERATORS**
Development of techniques for evaluating performance of air breathing engines and measurement of significant operating parameters
[NASA-TM-X-68305] c28 N72-20983
**GAS LASERS**
FORTRAN 4 program for calculating small signal gain and maximum available energy for CO-2-N2-H20 gas dynamic lasers
[AD-735878] c16 N72-21509
Military research in microelectronics, chemical lasers, gas lasers, and avionics
[AD-735869] c34 N72-21986
**GAS MIXTURES**
Vibrational relaxation for gaseous mixtures of CO and Ar using rapid heating and cooling rates
[DLR-FB-71-62] c12 N72-21315
**GAS PRESSURE**
Computer program for calculating partial pressure of selected gases from residual gas analyzer ion spectra
[NASA-CR-125938] c06 N72-21096
**GAS REACTORS**
Critical experiments for determining gas flow patterns of gas core reactor
[NASA-CR-120824] c22 N72-21645
Calculation of critical fuel mass for coaxial-flow gas-core reactors for specific conditions of operation
[NASA-TM-X-2534] c22 N72-21646
**GAS TURBINE ENGINES**
Exhaust emissions tests of aircraft propulsion and auxiliary power gas turbine engines
[PB-204920] c02 N72-21018
Numerical analysis of parameters in multistage gas turbine engines and components
[AD-736489] c28 N72-21827
**GAS TURBINES**
Numerical process for analyzing and summarizing fluid viscosity data over extended temperature ranges
[AD-735270] c15 N72-21499
**GAS-METAL INTERACTIONS**
Infrared spectroscopic examination of adsorption on clean metal surface produced by interaction of gases under high vacuum
[NLL-RTS-6710] c26 N72-21699

**GAS-SOLID INTERFACES**
Using two-dimensional Lagrangian code to computer growth of perturbed interface between perfect gas and aluminum
[LA-4754] c12 N72-21319

**GASEOUS DIFFUSION**
Carbon and gaseous isotope separation, diffusion in hydrogen-helium systems, and low temperature He-3 distillation
[MLM-1861] c06 N72-21110

**GASES**
Coulometric measurement of micro-impurities of nitrogen oxide, sulfur dioxide, and ammonia in gases
[NLL-M-22136-[5828.4F]] c14 N72-21404
High speed scanner for measuring mass of preselected gases at high sampling rate
[NASA-CASE-LAR-10766-1] c14 N72-21432

**GATES [CIRCUITS]**
Two fast gates using snap-off diodes for time-to-amplitude converter
[CEA-N-1491] c09 N72-21257

**GENERAL AVIATION AIRCRAFT**
Compilation of US general aviation accidents for 1969 in which impairment of judgement and efficiency by alcohol was involved
[PB-204991] c02 N72-21023
Compilation of accidents involving helicopters and rotor craft for United States general aviation operations during 1969
[PB-204812] c02 N72-21024
Compilation of United States general aviation accidents involving weather as cause or cause related factor year 1969
[PB-204926] c02 N72-21026
Use of shoulder harness in general aviation aircraft to prevent or minimize injury during crashes
[FAA-AM-72-3] c05 N72-21077
Design and development of collision avoidance system for use with general aviation aircraft
[NASA-CR-112023] c21 N72-21625

**GEOCHEMISTRY**
Geochemical studies using Th and U isotopes as geological indices in marine environments
[ORO-3622-12-PT-1] c13 N72-21366

**GEODESY**
Determination of earth figure, and substitution of mathematical model for earth
c13 N72-21344
Analysis of Molodenskii mathematical model of earth figure, and application to test areas in Czechoslovakia
c13 N72-21345
Correlation between deflections of verticals and axes of zones of increased macroseismic mobility, and agreement with tectonic dislocation lines
c13 N72-21346

**GEOIDS**
Geoid and gravity data based on satellite orbital elements
c13 N72-21333

**GEOLOGICAL FAULTS**
Tilt steps associated with local, regional and distant earthquakes
[RLO-2229-T-4-1] c13 N72-21367

**GEOMAGNETISM**
Gravity anomalies, seismic data, geomagnetism, and electrical conductivity of earth crust and upper mantle, and specific data for Czechoslovakia
c13 N72-21329
Paleomagnetism, archeomagnetism, magnetic properties of rocks and minerals, and geomagnetic field models
c13 N72-21347
Tabulation of geomagnetic data recorded by Spanish geophysical observatories in 1968
c13 N72-21372
Meteorology, geomagnetism, auroras, airglow, and ionosphere - bibliography
c34 N72-21974

**GEOMORPHOLOGY**
Application of aerial photographic interpretation in field and office geomorphological research
[NASA-TT-F-624] c13 N72-21364

**GEOPHYSICS**
Research and development on aeronautics, biochemistry, and geophysics
[AD-735897] c34 N72-21987

**GEOPOTENTIAL**
Computation of nearly circular satellite orbit perturbation due to geopotential harmonics
[ESRO-SR-13] c30 N72-21873

**GEOS-C SATELLITE**
Tradeoffs and requirements for GEOS-C laser cube-corner reflector panels to give stronger returns at lower elevation angles and reduce pulse spread in return
[NASA-TM-X-65862] c31 N72-21890

**GEOSTROPHIC WIND**
Tests of proposed ballistic wind determination technique using SIRS data from Nimbus 3 and 4 satellites
[AD-735898] c13 N72-21393

**GERMANIUM**
Influence of fast neutron bombardment on transport properties of carriers in n-type germanium
[ORO-3651-10] c24 N72-21679
Verification of Franz-Keldysh theory predictions as shown by interference of light and heavy hole contributions to electroreflectance spectrum of germanium
c26 N72-21754
Quantum cyclotron resonance spectrum of holes in degenerate valence bands of Ge analyzed using concept of critical point in magnetic joint density of states
c26 N72-21756

**GERMANIUM OXIDES**
Correlating electronic energy bands of tetragonal GeO2 with optical properties
c26 N72-21716

**GLASS FIBERS**
Lathe tool and holder combination for machining resin impregnated fiberglass cloth laminates
[NASA-CASE-XLA-10470] c15 N72-21489

**GLASSWARE**
On-line adaptive controller for drawing and coating of glass rods for resistors
[AD-735154] c15 N72-21500

**GLOBAL ATMOSPHERIC RESEARCH PROGRAM**
Report of second session of GARP Atlantic Tropical Experiment [GATE] for presentation of preliminary plan
[GARP-SPEC-5] c20 N72-21591

**GLOBES**
Orbital and entry tracking accessory mounted on global map to provide range requirements for reentry vehicles to any landing site
[NASA-CASE-LAR-10626-1] c14 N72-21416

**GLYCOLS**
Polyimide foams produced in presence of alkanolamine or siloxane-glycol polymer
[NASA-CASE-ARC-10464-1] c06 N72-21102

**GLYCOLYSIS**
Lactate-pyruvate and redox state responses of blood and tissue in chronic hypercapnia
[AD-734120] c04 N72-21057
Glycolytic metabolism effects from responses of blood lactate-pyruvate and redox state to chronic exposure to 3 percent CO2
[AD-734122] c04 N72-21059

**GOLD**
X ray photoelectron spectroscopic measurements of valence bands of AuAl2 and AuGa2, and gold 5d band dilemma
c26 N72-21796

**GOLD ALLOYS**
High temperature, low stress creep in dispersion strengthened gold-alumina alloys
[AD-735710] c17 N72-21549
Construction of density of states histogram for AuAl2 using augmented plane wave calculations of the valence and conduction bands
c26 N72-21738
Measurement of soft X ray emission spectrum of aluminum in gold aluminide alloy and comparison orbital state density at aluminum sites
c26 N72-21739
Measurement of changes in reflectivity upon alloying of small amounts of Ag, Cu, and Fe into Au
c26 N72-21769
Electrical resistivity changes in gold-palladium alloys during hydrogen absorption
c26 N72-21786

**GRAPHITE**
Santa Maria coke, raw materials, hydrogen analysis of commercial cokes and graphites, and image analyzing apparatus
[NASA-CR-125937] c06 N72-21097
Thermodynamics of capillary porous body/liquid system involving graphite, water, and chlorides
c18 N72-21519
Interaction process of ZrO2 with graphite powder
c18 N72-21520
Behavior of ATJ-S graphite under multiaxial stress states
[AD-736470] c18 N72-21565
Hydrostatic pressure effects on Hall effect and magnetoresistance in graphite crystals with current flow in basal planes
c18 N72-21785

**GRATINGS [SPECTRA]**
Human visual acuity measured by chromatic square wave gratings under luminance conditions
[AD-734931] c04 N72-21063

**GRAVIMETRY**
Experimental aerial gravimetry program to determine feasibility of large scale aerial gravity surveys
[AD-735266] c13 N72-21394

**GRAVITATION**
Mathematical models for computing gravity terrain corrections inside and outside circle of 5.26 km radius
c13 N72-21332
Geoid and gravity data based on satellite orbital elements
c13 N72-21333
Small displacement/small strain finite element technique for gravity flow initiation analysis
[PB-205504] c30 N72-21877

**GRAVITATIONAL FIELDS**
Interpretation of gravity anomalies and computation of gravitational fields of three and two dimensional bodies
c13 N72-21331
Correlation of gravity anomalies and isostasy, and theory of homogeneous random fields applied to interpretation of gravity fields
c13 N72-21334
East-west and north-south polygons for measuring secular variations of gravity field in Czechoslovakia
c13 N72-21336
Correlation between deflections of verticals and axes of zones of increased macroseismic mobility, and agreement with tectonic dislocation lines
c13 N72-21346

**GRAVITY ANOMALIES**
Gravity anomalies, seismic data, geomagnetism, and electrical conductivity of earth crust and upper mantle, and specific data for Czechoslovakia
c13 N72-21329
Interpretation of gravity anomalies and computation of gravitational fields of three and two dimensional bodies
c13 N72-21331
Correlation of gravity anomalies and isostasy, and theory of homogeneous random fields applied to interpretation of gravity fields
c13 N72-21334
Gravity anomalies and earth crust structure in Bohemian Massif and West Carpathian regions of Czechoslovakia
c13 N72-21335
Free air gravity and computed free air anomalies obtained along 150 deg meridian
[AD-735114] c13 N72-21375

**GRAVITY WAVES**
Meso-scale waves in jet stream and effect of gravity inertial waves
[NLL-M-22060-[5828.4F]] c13 N72-21353
Spectrum analysis of internal acoustic gravity waves based on CW Doppler data
[NASA-CR-2033] c13 N72-21365
Acoustic and internal gravity wave propagation and turning points
[AD-735386] c13 N72-21381

**GREAT BRITAIN**
Procedures for training pilots in assessment of flight systems during attendance at Empire Test Pilot School, England
c11 N72-20995

**GREEN FUNCTION**
Numerical analysis and establishment of relationships for one-particle spectral function for conduction and core electrons in metals
c26 N72-21730

**GROUND EFFECT MACHINES**
Conceptual design of 20-ton wheeled air cushion lighter to transport cargo from ships to shore and inland
[AD-735667] c02 N72-21012

**GROUND HANDLING**
Simulation of turnaround operation of passenger aircraft using critical path method for improving aircraft/terminal utilization
c34 N72-21970

**GROUND STATIONS**
Spacecraft transponder and ground station radar system for mapping planetary surfaces
[NASA-CASE-NPO-11001] c07 N72-21118
Determination of effects of shock heating of radome on radar range of ground station
c07 N72-21158
Project coordination and mission support for spacecraft operations noting data acquisition and transmission - conferences
[ESRO-SP-64] c11 N72-21291
Project and mission planning for European space programs
c11 N72-21293
Satellite control noting CNES ground station network
c11 N72-21297
Analysis of earthquake-explosion seismographic data based on results from seismic detection and earth noise investigations
[AD-735765] c13 N72-21399

**GROUND WATER**
Water movement through surface soil layers
[NASA-TT-F-14247] c13 N72-21360

**GROUP THEORY**
Application of group theory to calculation of influence of electric field on electron paramagnetic resonance spectrum in ruby
[AD-735814] c26 N72-21807

**GRUNEISEN CONSTANT**
Volume dependence of electron specific heat for superconducting gallium, aluminum, and thorium, for obtaining volume dependence of electronic density of states
c26 N72-21787

**GULF STREAM**
Transport float and hydrographic station data from three transects of Gulf Stream between Cape Cod and Bermuda
[AD-734419] c13 N72-21374

**GUNN EFFECT**
Gunn effect microwave diodes with RF shielding
[NASA-CASE-ERC-10119] c26 N72-21701
Microwave-oscillation in gallium arsenide diodes including Gunn effect
[REPT-1891] c26 N72-21801
**GUNS (ORDNANCE)**
Cost estimates for pintle, side mounted, and turret armament subsystems
[AD-735495] c34 N72-21988
**GYRATORS**
Gyrator circuit using MOS field effect transistors
[NASA-CASE-MFS-21433] c09 N72-21255
Analysis of parameters of Riordan gyrator and application as simulated inductor in electric filter networks
[AD-736533] c09 N72-21271
**GYROSCOPES**
Euler equations of motion for dynamics of gyroscope on elastic suspension
[SC-T-713086] c14 N72-21437
Stability and control moment gyro wobble damping of flexible, spinning space stations, using digital computer program
[NASA-CR-115525] c31 N72-21892

## H

**HABITABILITY**
Crew facilities and operations for modular space stations
[NASA-CR-121087] c31 N72-21883
**HADRONS**
Electron-positron storage rings noting QED, vector meson, and hadronic experiments
[NOTA-INTERNA-343] c24 N72-21686
Ultrahigh energy cosmic ray attenuation due to hadron production
[RIFP-142] c29 N72-21830
**HALDEN BOILING WATER REACTOR**
Use and properties of mild steel in Halden boiling water reactor
[HPR-143] c22 N72-21650
**HALIDES**
Apparatus which separately evaporates halides and mixes vapors
c15 N72-21521
**HALL EFFECT**
Hydrostatic pressure effects on Hall effect and magnetoresistance in graphite crystals with current flow in basal planes
c18 N72-21785
**HALOS**
Comparison of energetic storm protons and halo protons based on Explorer 34 data
c29 N72-21839
**HAND (ANATOMY)**
Mechanically operated hand which can depress trigger using touch control device
[NASA-CASE-MFS-20413] c15 N72-21463
**HANDLING EQUIPMENT**
Ground and vehicle systems for liquid fluorine space shuttle
[AD-735290] c27 N72-21812
**HARMONIC GENERATIONS**
Band structure and density of states in zincblende-type semiconductors used to calculate nonlinear optical susceptibility responsible for second harmonic generation
c26 N72-21792
**HARNESSES**
Use of shoulder harness in general aviation aircraft to prevent or minimize injury during crashes
[FAA-AM-72-3] c05 N72-21077
Effectiveness of restraint equipment in controlling head impact forces and body kinematics in enclosed aircraft areas
[FAA-AM-72-6] c05 N72-21078
**HAZARDS**
Lightning initiated by human activities
[AD-735917] c13 N72-21392
**HEAD (ANATOMY)**
Effectiveness of restraint equipment in controlling head impact forces and body kinematics in enclosed aircraft areas
[FAA-AM-72-6] c05 N72-21078
**HEALTH PHYSICS**
Effects of atmospheric odorous exposure on community health and annoyance reactions
[PB-204989] c20 N72-21598
**HEAO**
Summary of Phase A of High Energy Astronomy Observatory Mission-C
[NASA-TM-X-64652-VOL-1] c11 N72-21282
Analysis and conceptual design of baseline mission and spacecraft for HEAO-C
[NASA-TM-X-64652-VOL-2] c11 N72-21283
Supporting technical data, and alternate experiments and spacecraft configurations for HEAO-C
[NASA-TM-X-64652-VOL-3] c11 N72-21284
**HEART DISEASES**
Portable equipment for detecting myocardial activity
[AD-735882] c05 N72-21084
**HEART RATE**
Characteristics of heart rate information during sleep, and extracting sleep information from heart rate data
[AD-734283] c04 N72-21061
**HEAT EXCHANGERS**
Passive thermal control for storage battery using heat exchanger
[AD-735736] c03 N72-21037
Gas heat transfer in heat exchangers
[NLL-M-22137-[5828.4F]] c33 N72-21951
**HEAT FLUX**
Effect of nonuniform heat flux along channel length of critical heat flux for boiling potassium in tubes
[BNL-TR-458] c33 N72-21957
**HEAT PIPES**
Reference design for thermoelectric isotope power unit using potassium heat pipes
[ORNL-TM-2959] c33 N72-21958
**HEAT RESISTANT ALLOYS**
Pressure tight seal for superalloy used in hypersonic aircraft fuel tank joints
[NASA-CASE-LAR-10170-1] c15 N72-21471
Superalloy material from prealloyed powders
[NASA-CASE-LEW-10805-2] c15 N72-21485
Microstructure and mechanical properties of superalloy produced by gradient-annealing prealloyed powder extrusions
[NASA-TM-X-2545] c17 N72-21527
Strength and deformation properties of heat resistant alloys at high temperatures
[JPRS-55556] c17 N72-21531
Compatibility of strontium compounds with superalloys at 900 and 1100 C
[ORNL-4625] c17 N72-21541
**HEAT SHIELDING**
Hot salt stress corrosion cracking of titanium alloys used as radiative heat shields in space shuttles
[NASA-TM-X-68304] c17 N72-21926
Effects of fabrication-induced defects on performance of ablative heat shield materials in simulated space shuttle reentry
[NASA-CR-2010] c33 N72-21954
Jet blast deflector for controlling shipboard flight deck environment
[AD-735877] c33 N72-21963
**HEAT TRANSFER**
Pressure loss and heat transfer for electrically heated rough rods in concentric smooth tubes
[NP-19112] c22 N72-21649
Momentum and heat transfer in turbulent flow of air in fuel assembly model
[ZJE-111] c22 N72-21651
Nucleate boiling heat transfer in binary liquid mixtures, using copper plate and platinum wire
[NLL-LB/G/3091-[9091.9F]] c33 N72-21949
Gas heat transfer in heat exchangers
[NLL-M-22137-[5828.4F]] c33 N72-21951
Numerical analysis of vaporization time of drops in film boiling with consideration of diffusive and radiative effects
[NASA-TM-X-68037] c33 N72-21953
Development of sensors for detecting amount of ablation over ablating surfaces and change in boundary layer flow conditions
[NASA-CASE-LAR-10439-1] c33 N72-21956
Heat transfer and fluid flow characteristics of cylindrical enclosure having rotating and stationary walls in coolant throughflow
[AD-735492] c33 N72-21959
Boiling point depressor and absorbent in constant total pressure evaporation process with heat reuse by built-in engine
[PB-206619] c33 N72-21960
Thermoelastic stress conditions and heat conductivity of plates and bodies of revolution
[AD-735582] c33 N72-21961
**HEAT TREATMENT**
Heat treatment of hydrolytically degraded polyimide film and regeneration of tensile properties
[RM-538] c06 N72-21104
Effects of heat treatment, size, specimen type, and test environment on two precipitation-hardened stainless steels during stress corrosion cracking tests
c17 N72-21923
Influence of thermomechanical treatment on stress corrosion cracking in steel
c17 N72-21930
**HEAVY ELEMENTS**
Application of position-sensitive semiconductor detectors to study heavy element nuclear reactions at intermediate energies
[MNC-3783-10] c14 N72-21442
Measurements of low energy solar cosmic ray O/He, Si/He, and Fe/He ratios during Jan. 25, 1971 solar flare event
c29 N72-21846
**HELICOPTERS**
Compilation of accidents involving helicopters and rotor craft for United States general aviation operations during 1969
[PB-204812] c02 N72-21024
Central digital computers for helicopter guidance and control systems
c08 N72-21223
**HELIUM**
Attenuation coefficient of third sound in liquid He film and stability of quantized persistent calculations of thin helium film in Landau region
[AD-735924] c33 N72-21964
**HELIUM ISOTOPES**
Discovery of antihelium 3 nuclei and excitons
[NLL-M-22112-[5828.4F]] c34 N72-21966
**HEMODYNAMIC RESPONSES**
Effects of prolonged exposure to hyperoxia environment on coagulating processes of blood
[JPRS-55553] c04 N72-21044
**HIGH ALTITUDE**
Polarization coupling losses on sky wave paths at high altitude
c07 N72-21145
**HIGH ALTITUDE BALLOONS**
Development and characteristics of balloon interrogation package for use with Nimbus 4 satellite
[NASA-CR-122375] c14 N72-21410
**HIGH ALTITUDE TESTS**
Effects of high altitude on cellular and energy metabolism in rats
[AD-734933] c04 N72-21064
**HIGH ENERGY INTERACTIONS**
Angular behavior of K/Pi ratio at high energy in multi-Regge model
[NOTA-INTERNA-338] c24 N72-21688
Muon pair production by electron-positron annihilation at energies up to 2.1 GeV
[NOTA-INTERNA-336] c24 N72-21689
**HIGH FREQUENCIES**
Propagation loss, spectral spreading, and temporal spreading of high altitude HF signal transmission
c07 N72-21144
Use of high frequency antenna arrays to reduce conduction losses normally associated with antenna operating on or in proximity to earth surface
[AD-735682] c07 N72-21173
Requirements for high frequency aircraft antennas
[AD-735886] c07 N72-21176
Utilization of natural plant growth to model HF-VHF radio transmission in jungle forest type terrain
[AD-735335] c07 N72-21180
**HIGH PRESSURE**
Effects of high pressure on spectroscopic properties of aromatic hydrocarbons
[AD-735163] c06 N72-21116
Liquid aerosol dispenser with explosively driven piston to compress light gas to extremely high pressure
[NASA-CASE-MFS-20829] c12 N72-21310
**HIGH PRESSURE OXYGEN**
Effects of prolonged exposure to hyperoxia environment on coagulating processes of blood
[JPRS-55553] c04 N72-21044
**HIGH RESOLUTION**
High resolution interferometric observations of galactic center
[AD-734376] c29 N72-21854
**HIGH STRENGTH ALLOYS**
Standardization of test procedures for determining stress corrosion cracking in high strength alloys and steels under various environments - conference
[AGARD-CP-98] c32 N72-21900
Stress corrosion tests of 7XXX series high strength aluminium alloys in laboratory environment
c14 N72-21903
Cantilever bending tests for determining susceptibility of high strength alloys to stress corrosion cracking
c14 N72-21911
Analysis of crack initiation and crack propagation in high strength Al alloys in different environments
c14 N72-21918
**HIGH STRENGTH STEELS**
Room temperature tensile and compressive stress-strain diagrams for high strength steels
[AD-735314] c17 N72-21552
Standardization of test procedures for determining stress corrosion cracking in high strength alloys and steels under various environments - conference
[AGARD-CP-98] c32 N72-21900
Determination of stress corrosion cracking parameters for 300M steel
c32 N72-21906
Threshold stress intensity values and crack propagation rates for stress corrosion of high strength steels in aqueous environment
c32 N72-21913
Acoustic emission technique for determining crack growth rate in high strength cantilever steel type specimens
c14 N72-21917
**HIGH VACUUM**
Infrared spectroscopic examination of adsorption on clean metal surface produced by interaction of gases under high vacuum
[NLL-RTS-6710] c26 N72-21699
**HISTOGRAMS**
Construction of density of states histogram for AuAl2 using augmented plane wave calculations of the valence and conduction bands
c26 N72-21738

**HOLES [ELECTRON DEFICIENCIES]**
Development of numerical process for estimating enhancement factor on intensity of soft X ray emission in metals due to effect of core hole
c26 N72-21733
Verification of Franz-Keldysh theory predictions as shown by interference of light and heavy hole contributions to electroreflectance spectrum of germanium
c26 N72-21754
Quantum cyclotron resonance spectrum of holes in degenerate valence bands of Ge analyzed using concept of critical point in magnetic joint density of states
c26 N72-21756

**HOLOGRAPHY**
Holographic recording of limestone pollution by back or side scattering of ruby laser beam
[PB-205189] c14 N72-21457
Radiation effects on properties of photochromic materials incorporated in plastics and used in holography and other optical data processing methods
[LCR-DR-70-90/1/R] c23 N72-21664

**HOMOGENEOUS TURBULENCE**
Measurement of wind and temperature profiles and turbulent fluctuations in wind velocity under homogeneous turbulence
[AD-735393] c20 N72-21603

**HONEST JOHN ROCKET VEHICLE**
Meteorological parameters for Honest John missile launch
[AD-735362] c20 N72-21597
Meteorological data tables for launching Honest John missile number 354, round number 613 RML
[AD-735354] c20 N72-21621

**HORIZON SCANNERS**
Method and equipment for locating earth infrared horizon from space, independent of season and latitude
[NASA-CASE-LAR-10726-1] c14 N72-21419

**HOVERING**
Application of programmed pilotage techniques to vary aerodynamic parameters during flight for enhancement of level flight speed characteristics of VTOL aircraft
[AD-736537] c02 N72-21032

**HUMAN BODY**
Clinical treatment of vibration induced disorders in construction workers
[RAE-LIB-TRANS-1611] c04 N72-21051

**HUMAN FACTORS ENGINEERING**
Analysis of pedal operation by seated operator with application to design of foot controls for automobiles and other equipment
[AD-735315] c05 N72-21089

**HUMAN PERFORMANCE**
Parametric analysis of intravehicular manned cargo transfer in simulated weightlessness
[NASA-TN-D-6774] c05 N72-21075
Automated instructional monitors for diagnosing student difficulties in acquiring complex concepts and skills
[AD-736212] c05 N72-21090

**HUMAN REACTIONS**
Mathematical models for analyzing sequential and continuous motor behavior in humans
[AD-734681] c04 N72-21060
Effects of atmospheric odorous exposure on community health and annoyance reactions
[PB-204989] c20 N72-21598

**HYDRAULIC EQUIPMENT**
Design, development, and characteristics of variable delivery, positive displacement fuel pump for use with J-85 turbine engine fuel system
[AD-735259] c15 N72-21496
Elastomers for gaskets in pneumatic and hydraulic systems
[NASA-TN-D-6693] c18 N72-21556

**HYDRAZINES**
Specification for performance, design, fabrication, test and quality assurance for electrothermal hydrazine thrustor
[NASA-CR-122377] c28 N72-21820

**HYDROCARBONS**
Effects of high pressure on spectroscopic properties of aromatic hydrocarbons
[AD-735163] c06 N72-21116

**HYDROGEN**
Santa Maria coke, raw materials, hydrogen analysis of commercial cokes and graphites, and image analyzing apparatus
[NASA-CR-125937] c06 N72-21097
Atomic hydrogen maser with automatic bulb temperature control to eliminate frequency shift due to collision of hydrogen atoms with storage bulb walls
[NASA-CASE-HQN-10654-1] c16 N72-21502
Ultrahigh vacuum for determining effects of hydrogen on fatigue and fracture properties of Ni 200
c14 N72-21916

**HYDROGEN ATOMS**
Electrical resistivity changes in gold-palladium alloys during hydrogen absorption
c26 N72-21786

**HYDROGENATION**
Hydrogenation unit with reaction chamber of hydrogen-permeable palladium alloy
[NASA-CASE-NPO-11682] c15 N72-21474
Hydrogenation effects on electron tunneling characteristics of aluminum-oxide-palladium junctions
c26 N72-21789

**HYDROGRAPHY**
Transport float and hydrographic station data from three transects of Gulf Stream between Cape Cod and Bermuda
[AD-734419] c13 N72-21374

**HYDROLOGY**
Application of infrared sensing techniques to water exploration
[NASA-CR-126025] c13 N72-21357

**HYDROMECHANICS**
Application of finite difference and finite element methods for analyzing symmetric fluid oscillations
[DLR-FB-71-69] c12 N72-21316

**HYDROMETEOROLOGY**
Appraisal of adequacy of hydrometeorological information in western basins for water resources planning
[PB-204939] c20 N72-21609

**HYDROPHONES**
Environmental tests of hydrophones to obtain acceleration response measurements
[AD-735931] c13 N72-21391
Effectiveness of system for towing deep submerged hydrophone array
[AD-735885] c23 N72-21671

**HYPERBARIC CHAMBERS**
Development and tests of sensitive methodologies for measuring sensory and motor impairment in hyperbaric environments
[AD-735117] c04 N72-21062
Whole body plethysmograph system for use in measuring airway resistance under ambient hyperbaric conditions for normal breathing patterns
[AD-735462] c05 N72-21081

**HYPERBOLIC NAVIGATION**
Development of technique for increasing accuracy of Omega navigation system
[AD-735372] c21 N72-21635

**HYPERCAPNIA**
Lactate-pyruvate and redox state responses of blood and tissue in chronic hypercapnia
[AD-734120] c04 N72-21057
Plasma creatine phosphokinase response to hypercapnia
[AD-734126] c04 N72-21058

**HYPERFINE STRUCTURE**
Knight shifts and temperature dependence in electron density of states of transition metals
c26 N72-21776
Interpretation of absolute Knight shifts of alkalis, variations with pressure, and absolute Knight shifts in binary alkali systems
c26 N72-21778

**HYPEROXIA**
Effects of prolonged exposure to hyperoxia environment on coagulating processes of blood
[JPRS-55553] c04 N72-21044

**HYPERSONIC AIRCRAFT**
Pressure tight seal for superalloy used in hypersonic aircraft fuel tank joints
[NASA-CASE-LAR-10170-1] c15 N72-21471

**HYPERSONIC BOUNDARY LAYER**
Implicit finite difference scheme for numerical integration of equations governing hypersonic slipflow-boundary layers
[DLR-FB-71-97] c12 N72-21317

**HYPERSONIC FLIGHT**
Problems in aerodynamics of sustained hypersonic flight
[NASA-TT-F-14235] c02 N72-21006

**HYPERSONIC FLOW**
Numerical conversion of three dimensional stationary detached flow to two dimensional nonstationary detached flow about flat bodies
[AD-735604] c12 N72-21322

**HYPERSONIC VEHICLES**
Triethyl aluminum as fuel or fuel additive for heat addition by external combustion hypersonic vehicle
[DLR-MITT-71-26] c28 N72-21822

**HYPERSONICS**
Nonequilibrium boundary layer flow at leading edge of highly swept hypersonic infinite span wing
[PB-204710] c01 N72-20975

**HYPERVELOCITY PROJECTILES**
Differential interferometer to study shock induced combustion by hypervelocity projectile in detonable gas mixture
[ISL-7/70] c14 N72-21446

**HYPERVENTILATION**
Electromyographic measurement of maximum voluntary muscle contraction endurance in chronic hyperventilators
[AD-734298] c04 N72-21072

**HYPOKINESIA**
Clinical analysis of hypokinesia caused changes in nervous system and effects of pharmocological preparations on hypokinesia disorders
[NASA-TT-F-14225] c04 N72-21046

**HYPOXIA**
Response of ventilation parameters, pulse rate, oxygen uptake, and body temperature in man under acute and severe hypoxia
[DLR-FB-71-65] c04 N72-21053


## I


**IDEAL FLUIDS**
Steady barotropic flow of ideal fluid
[NLL-M-22062-[5828.4F]] c12 N72-21309

**IDEAL GAS**
Using two-dimensional Lagrangian code to computer growth of perturbed interface between perfect gas and aluminum
[LA-4754] c12 N72-21319
Power series solutions for supersonic flow in ideal dissociating gas
[AD-735697] c12 N72-21323

**IMAGE CONVERTERS**
Matrix element of solid state ultrasonic image converter using light emitting diode in nonscanning display for acoustic imaging of underwater objects
[AD-736535] c09 N72-21272

**IMAGE INTENSIFIERS**
Low light image recording system for recording data from optical telescopes
[AD-735830] c23 N72-21669

**IMAGES**
Santa Maria coke, raw materials, hydrogen analysis of commercial cokes and graphites, and image analyzing apparatus
[NASA-CR-125937] c06 N72-21097
Computer program for analysis of general optical systems
[AD-735674] c16 N72-21510
Family of physical correction filters for improving optical quality of image
[NASA-CASE-HQN-10542-1] c23 N72-21663

**IMPACT**
Crater classification and impact explosion origin of small lunar craters
[NASA-TT-F-14177] c30 N72-21867

**IMPACT DAMAGE**
Numerical analysis and theoretical discussion of effects of high velocity liquid impact and cavitation flow
c12 N72-21314

**IMPACT LOADS**
Effects of exposure to blast induced winds and pressure variations on biophysical parameters
[AD-734208] c04 N72-21054

**IMPACT STRENGTH**
Developing boride composites with metal additives for lowering fabrication temperatures and increasing impact strength
[NASA-CR-126246] c18 N72-21555

**IMPLANTATION**
Vapor cycle engine for driving Pu 238 fueled heart assist system
[PB-205474] c05 N72-21086

**IMPURITIES**
Coulometric measurement of micro-impurities of nitrogen oxide, sulfur dioxide, and ammonia in gases
[NLL-M-22138-[5828.4F]] c14 N72-21404
One-dimensional Dirac equation solved for Kronig-Penney model containing delta-potential impurity
c26 N72-21761
Evaluation of excluded terms in multiple scattering series for electron in presence of several impurities
c26 N72-21766

**INDEXES [DOCUMENTATION]**
Abstracts, bibliographies, and index on Soviet cybernetics
[AD-735651] c10 N72-21278

**INDIA**
Synoptic meteorological data tables of Indias coastal marine areas
[AD-735441] c20 N72-21594

**INDIAN OCEAN**
Oceanographic and climatic influence on Indian Ocean thermal structures in upper layers
[AD-734668] c13 N72-21378

**INDIUM**
Interpreting photoemission data from indium and aluminum in terms of density of states models
c26 N72-21721
Density of states from superconducting critical field measuremnts in indium and thallium
c26 N72-21782

**INDIUM ALLOYS**
Fermi surface topology information on indium cadmium alloy system from superconductivity measurements
c26 N72-21788

**INDIUM ANTIMONIDES**
Application of electroreflectance techniques to determine band population effects in indium antimonide
c26 N72-21752
Electron density of states and variation of infrared cyclotron resonance near conduction band edge of InSb
c26 N72-21755

**INDUSTRIAL PLANTS**
Simplified technique and device for producing industrial grade synthetic diamonds
[NASA-CASE-MFS-20698-2] c15 N72-21481
**INERTIAL NAVIGATION**
Navigation/guidance computer requirements for integrated navigation system using combination of outputs of inertial, Doppler, and loran equipment
c08 N72-21224
Air traffic control analysis of North Atlantic commercial aircraft operation based on inertial navigation and satellite surveillance
[DOT-TSC-FAA-71-13] c21 N72-21629
Application and effectiveness of Kalman filters for loran and inertial navigation systems
[AD-735331] c21 N72-21640
**INERTIAL PLATFORMS**
Determination of platform fluctuation in inertial navigation system due to dry friction in accelerometer
[AD-734920] c21 N72-21643
**INFLATING**
Inflatability and flotation of one man life raft after puncture to main wall
[NASA-CASE-LAR-10241-1] c05 N72-21076
**INFORMATION MANAGEMENT**
Computer systems program specifications for modular space station information management system
[NASA-CR-121088] c34 N72-21967
**INFORMATION SYSTEMS**
Small low cost computers with input/output capacities suitable for use in information centers
[NASA-CR-126039] c08 N72-21210
Information system for physics
[PB-204859] c34 N72-21990
**INFORMATION THEORY**
Design and characteristics of satellite communication system for naval communications
[AD-736115] c07 N72-21192
Waveform processing system as flexible on-line graphic interactive tool for signal classification
[AD-735749] c08 N72-21241
**INFRARED DETECTORS**
Application of infrared sensing techniques to water exploration
[NASA-CR-126025] c13 N72-21357
Development of high performance infrared photodetectors
[NASA-CASE-LAR-10728-1] c14 N72-21422
Improved detectivity of pyroelectric detectors through use of new materials and improved field effect transistors
[NASA-CR-122382] c14 N72-21427
Remote detection of fog banks using lidar backscattering and infrared radiometry
[PB-204805] c14 N72-21451
Photomultiplier tube for infrared detection
[AD-735323] c23 N72-21672
**INFRARED INSTRUMENTS**
Effect of background photon flux density on performance of infrared vidicons and infrared scanning systems
[AD-735324] c07 N72-21186
**INFRARED LASERS**
Estimation of beam spread of laser beam propagating in turbulent medium
[AD-735665] c16 N72-21508
**INFRARED RADIATION**
Infrared radiance from geological materials and system for airborne use over terrain with little vegetation
[NASA-CR-115524] c13 N72-21356
**INFRARED SCANNERS**
Effect of background photon flux density on performance of infrared vidicons and infrared scanning systems
[AD-735324] c07 N72-21186
Method and equipment for locating earth infrared horizon from space, independent of season and latitude
[NASA-CASE-LAR-10726-1] c14 N72-21419
**INFRARED SPECTRA**
1/f noise distribution in semiconductors
[AD-735944] c26 N72-21805
**INFRARED SPECTROMETERS**
Tests of proposed ballistic wind determination technique using SIRS data from Nimbus 3 and 4 satellites
[AD-735898] c13 N72-21393
**INFRARED SPECTROSCOPY**
Infrared spectroscopic examination of adsorption on clean metal surface produced by interaction of gases under high vacuum
[NLL-RTS-6710] c26 N72-21699
**INFRASONIC FREQUENCIES**
Microphone array for detection and recording of infrasound
[KGO-TR-71-105] c14 N72-21445
**INJECTORS**
Injector for introducing fluids into feed lines
[NASA-CASE-NPO-11377] c15 N72-21475
**INPUT/OUTPUT ROUTINES**
Small low cost computers with input/output capacities suitable for use in information centers
[NASA-CR-126039] c08 N72-21210
Aerospace computer input-output techniques for consideration in design phase of interfacing equipment
c08 N72-21219
**INSTRUMENT APPROACH**
Report of aircraft accident involving Beechcraft 99 air taxi at Allentown, Pennsylvania on 24 October, 1971
[NTSB-AAR-72-3] c02 N72-21002
**INSTRUMENT FLIGHT RULES**
Planning and management of air traffic control system based on random sample of flight plans filed at flight service stations during calendar year 1970
[AD-735970] c21 N72-21641
**INSTRUMENT PACKAGES**
Data acquisition and transmission methods in relation to ESRO satellites, with emphasis on onboard computers
c07 N72-21295
**INSTRUMENTS**
Characteristics of flight test instruments and techniques for overcoming limitation and sources of error
c02 N72-20984
Measurement of dynamic response characteristics of high frequency pressure transducers using large amplitude, sinusoidal pressure generator
[NASA-CR-2000] c14 N72-21412
**INSULATION**
Insulation tests for prestressed concrete reactor vessels of water reactors
[CONF-710903-6] c22 N72-21652
**INTAKE SYSTEMS**
Design problems of inlets and nozzles used in supersonic and V/STOL propulsion systems
[NASA-TM-X-67741] c28 N72-21819
**INTEGRATED CIRCUITS**
Beam lead integrated circuit package and method for preparing lead frame array
[NASA-CASE-MFS-21374] c10 N72-21274
Method and apparatus for testing integrated circuit microtab welds
[NASA-CASE-ARC-10176-1] c15 N72-21464
**INTELSAT SATELLITES**
Polarization characteristics of Intelsat 2F-1 signals
[KGO-721] c23 N72-21665
**INTERFERENCE DRAG**
Mutual aerodynamic interference effects on flow field beneath aircraft with external stores examined by cross flow corrections method
[AD-735655] c01 N72-20974
**INTERFEROMETERS**
Interferometers for use in Fourier spectroscopy capable of transforming one million samples
[NASA-CR-125980] c14 N72-21411
Interferometric prism and control system for precisely determining direction to remote light source
[NASA-CASE-ARC-10278-1] c14 N72-21434
High resolution interferometric observations of galactic center
[AD-734376] c29 N72-21854
**INTERFEROMETRY**
Interferometers for use in Fourier spectroscopy capable of transforming one million samples
[NASA-CR-125980] c14 N72-21411
**INTERIOR BALLISTICS**
Characteristics of solid propellant rocket engines for delivering high thrust with short impulse duration
[AD-735381] c28 N72-21823
**INTERMEDIATE FREQUENCIES**
Signal propagation at 400 kHz in oak trees using HEMAC
[AD-735330] c07 N72-21178
**INTERMETALLICS**
X ray photoelectron spectroscopic measurements of valence bands of AuAl2 and AuGa2, and gold 5d band dilemma
c26 N72-21796
**INTERMOLECULAR FORCES**
Description of special case of Frenkel model to define crystal system with steeply falling off intermolecular interactions
c26 N72-21732
**INTERNAL COMBUSTION ENGINES**
Mathematical models of nitrogen oxides in internal combustion engines
[NLL-M-22139-[5828.4F]] c33 N72-21948
**INTERNAL FRICTION**
Development of procedure for measuring coefficient of dynamic viscosity of liquids based on speed of plate moving through liquid
[AD-735640] c14 N72-21455
**INTERNATIONAL COOPERATION**
Control, tracking, data acquisition, and processing relating to ESRO satellites
c11 N72-21292
Case histories of international cooperation in field of ballistic ranges, sonic boom generators and simulation of nuclear blast in galleries
[ISL-4/71] c11 N72-21304
International survey of air pollution by aircraft engines and fuels
[AGARD-AR-40] c20 N72-21590
Report of second session of GARP Atlantic Tropical Experiment [GATE] for presentation of preliminary plan
[GARP-SPEC-5] c20 N72-21591
**INTERPLANETARY FLIGHT**
Performance characteristics and service life of silver oxide-zinc battery for synchronous orbit and planetary missions
[NASA-TM-X-68036] c03 N72-21034
**INTERPLANETARY SPACE**
Penetration of low energy solar protons and alpha particles in interplanetary space and magnetosphere to magnetic equator
c29 N72-21833
Temporal structure of solar protons detected in outer magnetosphere, interplanetary space, at synchronous altitude, and magnetotail
c29 N72-21835
Low energy solar protons and alpha particles detected during 1967 solar flare used to probe properties of interplanetary space
c29 N72-21838
Explorer 34 measurements of interplanetary solar protons and alpha particles during Oct. 26 through Nov. 1, 1968
c29 N72-21843
Bibliography on various features of interplanetary and interstellar space
c30 N72-21871
**INTERSTELLAR SPACE**
Bibliography on various features of interplanetary and interstellar space
c30 N72-21871
**INTERSTITIALS**
Application of soft X ray spectroscopy for determining electronic properties of titanium interstitial and intermetallic compounds
c26 N72-21743
**INTRAVEHICULAR ACTIVITY**
Parametric analysis of intravehicular manned cargo transfer in simulated weightlessness
[NASA-TN-D-6774] c05 N72-21075
Crew facilities and operations for modular space stations
[NASA-CR-121087] c31 N72-21883
**ION ATOM INTERACTIONS**
Application of ion-neutralization spectroscopy for determining local density of states of solids at solid surface
c14 N72-21747
**ION DENSITY [CONCENTRATION]**
Computer program for calculating partial pressure of selected gases from residual gas analyzer ion spectra
[NASA-CR-125938] c06 N72-21096
**ION ENGINES**
Development of procedure for calculating various interactions of ion thrusters with spacecraft surface
[NASA-TM-X-68043] c28 N72-21815
Grid accelerator system for ion thrustor
[NASA-CASE-XLE-10453-2] c28 N72-21821
**ION PROPULSION**
Development of procedure for calculating various interactions of ion thrusters with spacecraft surface
[NASA-TM-X-68043] c28 N72-21815
**IONIZATION**
Ionospheric refraction effect on geometry of field aligned ionization at HF and UHF in Northern Hemisphere
c07 N72-21152
**IONIZED GASES**
Differential calculus methods for determining conductivity of ionized gas and shock wave ionized plasmas
[FRNC-TH-75] c25 N72-21694
**IONOGRAMS**
Ionograms and morphological statistics of polar slant E condition, emphasizing two stream or plasma ion wave instability
c07 N72-21148
**IONOSPHERE**
Characteristics and effects of Arctic ionosphere on radio and radar propagation - conference
[AGARD-CP-97] c07 N72-21121
Models of Arctic ionosphere
c13 N72-21123
Intensity of weak scattering from electron density irregularities in ionosphere
c07 N72-21134
Development of optical striations and Doppler spectrum broadening due to barium plasmas in ionosphere
c07 N72-21136
Radio signals from Explorer 22 for ionospheric electron content
c07 N72-21141
Effect of earths magnetic field on electromagnetic wave propagation through ionosphere and electron clouds
[AD-735265] c07 N72-21177
Theoretical plasma physics and ionospheric plasmas
[NASA-CR-125979] c25 N72-21690
Penetration of high energy solar protons to ionospheric heights at magnetic equator
c29 N72-21834
Meteorology, geomagnetism, auroras, airglow, and ionosphere - bibliography
c34 N72-21974

**IONOSPHERIC DISTURBANCES**
Ionospheric irregularities causing high latitude satellite scintillation
c07 N72-21140
Sweep frequency backscatter radars as detectors of high latitude ionospheric phenomena
c07 N72-21147
High frequency backscatter observations of high latitude, field aligned irregularities in F region
c07 N72-21149
Ionospheric refraction effect on geometry of field aligned ionization at HF and UHF in Northern Hemisphere
c07 N72-21152
Ionospheric storm effect comparison over eight oblique sounder paths
[AD-735868] c07 N72-21175
Atmospheric model for echoes from weak D region disturbances
[AD-735514] c13 N72-21386
Development of theory for formation of stable auroral red arcs at plasmapause
[AD-736431] c13 N72-21403
**IONOSPHERIC PROPAGATION**
Ionospheric propagation model and application to high latitude HF radar propagation
c07 N72-21153
Capability of navigation satellite system for predicting ionospheric conditions for optimum transmitting parameters in high frequency sky wave telecommunication
[AD-735866] c07 N72-21174
**IONOSPHERICS**
Arctic ionogram sequences and auroral oval
c13 N72-21125
**IRON**
Interaction and marginal wetting angles of chromium and titanium borides with iron and nickel
c17 N72-21518
Magnetic ordering behavior in Cu-Ni alloys as function of Fe and Ni content
[BNL-16276] c17 N72-21540
Calculating band structure of ferromagnetic iron by variational method using tight binding functions and orthogonalized plane waves
c23 N72-21708
Measurement of changes in reflectivity upon alloying of small amounts of Ag, Cu, and Fe into Au
c26 N72-21769
Density of states curves used to obtain thermodynamic information associated with allotropic phase transitions in bcc and fcc iron
c26 N72-21790
**ISOSTASY**
Correlation of gravity anomalies and isostasy, and theory of homogeneous random fields applied to interpretation of gravity fields
c13 N72-21334
**ISOTOPE SEPARATION**
Methods of carbon isotope separation, thermal diffusion, and low temperature studies
[MLM-1828] c06 N72-21109
Carbon and gaseous isotope separation, diffusion in hydrogen-helium systems, and low temperature He-3 distillation
[MLM-1861] c06 N72-21110
**ISOTROPIC MEDIA**
Multiple scattering effects of wave propagation in isotropic scattering media with solution of equations for coherent field and average intensity
[AD-735284] c07 N72-21169
**ITERATION**
MIMUSA, matrix iteration method of unfolding spectra, using FORTRAN 4 subroutine
[RD/B/N-1962-PT-1] c08 N72-21228

## J

**J-85 ENGINE**
Design, development, and characteristics of variable delivery, positive displacement fuel pump for use with J-85 turbine engine fuel system
[AD-735259] c15 N72-21496
**JACOBI MATRIX METHOD**
Evaluation of Jacobian determinants occurring in classical mechanical and quasiclassical approximation descriptions of molecular scattering
[NASA-CR-125978] c06 N72-21095
**JET ENGINE FUELS**
Fungicidal potency of antiicing additive for jet fuel
[AD-735451] c04 N72-21068
Trace amounts of fuel-soluble metal compounds affecting thermal stability of JP-7 fuel
[AD-736475] c27 N72-21813
**JET EXHAUST**
Jet blast deflector for controlling shipboard flight deck environment
[AD-735877] c33 N72-21963
**JET FLOW**
Determining suitability of supersonic jets for proton beam neutralizer
[UCRL-51089] c12 N72-21318
**JET IMPINGEMENT**
Numerical analysis of aircraft noise created by externally blown flaps on STOL aircraft and methods for noise reduction
[NASA-TM-X-68047] c02 N72-21001
**JET STREAMS [METEOROLOGY]**
Meso-scale waves in jet stream and effect of gravity inertial waves
[NLL-M-22060-[5828.4F]] c13 N72-21353
**JOURNAL BEARINGS**
Journal bearing sectors for lubricant films
[NASA-CASE-LEW-11076-1] c15 N72-21473

## K

**K-MESONS**
Angular behavior of K/Pi ratio at high energy in multi-Regge model
[NOTA-INTERNA-338] c24 N72-21688
**KALMAN-SCHMIDT FILTERING**
Application and effectiveness of Kalman filters for loran and inertial navigation systems
[AD-735331] c21 N72-21640
**KINETIC ENERGY**
Vertical and horizontal distributions of atmospheric kinetic energy in June and Jan. over northern and southern USSR
[NLL-M-22049-[5828.4F]] c20 N72-21581
**KWIC INDEXES**
KWIC index and bibliography on biological effects related technology of lasers and light
[PB-205091] c04 N72-21070

## L

**LABORATORY EQUIPMENT**
Apparatus for mixing two or more liquids under zero gravity conditions
[NASA-CASE-LAR-10195-1] c15 N72-21488
Laboratory equipment for testing stress corrosion of bolt loaded WOL specimens and monitoring crack growth
c32 N72-21914
**LACTATES**
Glycolytic metabolism effects from responses of blood lactate-pyruvate and redox state to chronic exposure to 3 percent CO2
[AD-734122] c04 N72-21059
**LAKES**
Computerized simulation of relationships between barometric pressure, wind, waves, and currents on eastern shore of Lake Michigan
[AD-736224] c13 N72-21401
**LAMINAR BOUNDARY LAYER**
Nonequilibrium boundary layer flow at leading edge of highly swept hypersonic infinite span wing
[PB-204710] c01 N72-20975
**LAMINAR FLOW**
Computer program for solving compressible nonsimilar boundary layer equations for laminar, transitional, or turbulent flows of perfect gas
[NASA-TM-X-2458] c12 N72-21312
**LAMINATES**
Method for preparing laminates of stressed face sandwich structures with light weight cores
[NASA-CASE-XLA-11028] c15 N72-21486
**LANCE MISSILE**
Meteorological data tables for launching Lance missiles
[AD-735361] c20 N72-21595
Meteorological data tables for launching 12804 Lance missile number 2120 round number 137
[AD-735359] c20 N72-21607
Meteorological data tables for launching 11604 Lance missile number 5129 round number 138 RMT
[AD-735360] c20 N72-21608
Meteorological data tables for launching 12806 Lance missile number 2112 round 135
[AD-735358] c20 N72-21617
Meteorological and ballistics data for launching of Lance missile 2105, round 134
[AD-735357] c20 N72-21618
Meteorological data tables for launching 11601 Lance missile number 2171 round 132
[AD-735356] c20 N72-21619
Meteorological data tables for launching 12802 Lance missile number 2132 round 133
[AD-735355] c20 N72-21620
**LAND USE**
Review of land use models and application of specific models for various aspects of urban planning and development
c34 N72-21971
Development of concept for deterministic design of urban space allocation and urban transportation system
c34 N72-21972
**LANDAU DAMPING**
Attenuation coefficient of third sound in liquid He film and stability of quantized persistent calculations of thin helium film in Landau region
[AD-735924] c33 N72-21964
**LANDAU FACTOR**
Derivation of convolution integral expression of optical density of states for k-conserving transitions between broadened levels in crystalline solids
c26 N72-21757
**LANDING AIDS**
Development and characteristics of microwave scanning beam approach and landing system phased array antenna
[DOT-TSC-FAA-71-29] c21 N72-21627
Development of discrete address beacon system to improve operation of microwave landing system for high density terminal area surveillance
[DOT-TSC-FAA-71-26] c21 N72-21628
**LANGUAGE PROGRAMMING**
Structure and use of thesaurus for automatic language translation
[NLL-RTS-6886] c34 N72-21965
**LAP JOINTS**
Measurement of static strength of lap bolted joints of fibrous composite material reinforced with boron film
[AD-735953] c15 N72-21493
**LASER HEATING**
Analysis of mirror wave front distortions caused by Gaussian distributed laser radiation
[AD-735282] c23 N72-21668
**LASER MATERIALS**
Test methods for determining optical properties of neodymium-doped glass and ruby
[UCRL-73478] c16 N72-21504
**LASER OUTPUTS**
Plasma diagnostic methods for measuring laser dispersion and interferometric phenomena
[AD-735480] c25 N72-21696
Analysis of high temperature plasma heating phenomena produced by ultrashort laser pulses
[AD-736483] c25 N72-21698
**LASERS**
KWIC index and bibliography on biological effects related technology of lasers and light
[PB-205091] c04 N72-21070
Ocular laser protective filter with narrowband absorption, luminous transmission, and optical density of 3.5
[AD-735799] c05 N72-21083
Environmental tests on high contrast laser-photochromic projection device, based on random access positioning
[AD-735281] c09 N72-21263
Optical sensing of supersonic flows by correlating deflections in laser beams through flow
[NASA-CASE-MFS-20642] c14 N72-21407
Measurement of relative azimuth bearing using laser source for projecting collimated beam
[NASA-CASE-GSC-11262-1] c16 N72-21503
Polycrystalline oxide ceramic development, densification and porosity change kinetics, and Nd doped yttrium oxide rods as laser material
[AD-736223] c16 N72-21513
Tradeoffs and requirements for GEOS-C laser cube-corner reflector panels to give stronger returns at lower elevation angles and reduce pulse spread in return
[NASA-TM-X-65862] c31 N72-21890
**LATEX**
Nonflammable coatings of synthetic mica and silicate gelant solution mixed with latex paint for use in liquid oxygen or high oxygen gaseous atmospheres
[NASA-CASE-MFS-20486] c18 N72-21557
**LATHES**
Lathe tool and holder combination for machining resin impregnated fiberglass cloth laminates
[NASA-CASE-XLA-10470] c15 N72-21489
**LATITUDE**
VHF bistatic CW auroral backscattering and influence of daytime, seasonal, and geomagnetic latitude
c13 N72-21128
**LAUNCH WINDOWS**
Computer programming for determining moderate-to-highly eccentric satellite launch window considering satellite perturbations
[ESRO-SR-15] c30 N72-21874
**LEAD TELLURIDES**
Calculating density of states and optical properties of PbTe from augmented plane wave and linear combination of atomic orbital energy bands
c26 N72-21717
**LEADING EDGES**
Nonequilibrium boundary layer flow at leading edge of highly swept hypersonic infinite span wing
[PB-204710] c01 N72-20975
**LIAPUNOV FUNCTIONS**
Quadratic Liapunov functions for vector differential equations in adaptive control system models
[AD-735482] c19 N72-21573
Design of adaptive control systems using Liapunov method
[AD-735481] c19 N72-21574
**LIFE [DURABILITY]**
Zinc silver oxide secondary battery failure during cycle life tests
[AD-736016] c03 N72-21040

**LIFE RAFTS**
Inflatability and flotation of one man life raft after puncture to main wall
[NASA-CASE-LAR-10241-1] c05 N72-21076

**LIFE SUPPORT SYSTEMS**
Design data on electrical power, environmental control/life support, propulsion, and guidance, navigation, and control subsystems for modular space station
[NASA-CR-123545] c31 N72-21881

**LIFTING BODIES**
Techniques and procedures for conducting flight tests of lifting body type aircraft during transonic and supersonic flight conditions
[NASA-TM-X-68306] c02 N72-20986

**LIFTING ROTORS**
Vortex ring method used for calculations of aerodynamic characteristics of helicopter lifting rotors at any angle of attack in flow with comparatively high velocity
[AD-735439] c01 N72-20973

**LIGHT (VISIBLE RADIATION)**
KWIC index and bibliography on biological effects related technology of lasers and light
[PB-205091] c04 N72-21070
Device for detection of combustion light preceding explosion in coal mine
[NASA-CASE-LAR-10739-1] c14 N72-21424
Method and apparatus for producing intense, coherent, monochromatic light from low temperature plasma
[NASA-CASE-XNP-04167-3] c25 N72-21693

**LIGHT ALLOYS**
Analysis of soft X ray spectra in light metals and development of theory for emission and absorption cancellation effects
c26 N72-21734

**LIGHT SCATTERING**
Radiation measurements for determination of atmospheric dust particle concentration
[ISL-6/71] c13 N72-21373
Plasma diagnostic methods for measuring laser dispersion and interferometric phenomena
[AD-735480] c25 N72-21696

**LIGHT SOURCES**
Temperature compensated light source with light emitting diode and circuitry for maintaining luminous power independent of temperature changes
[NASA-CASE-ARC-10467-1] c09 N72-21249
Interferometric prism and control system for precisely determining direction to remote light source
[NASA-CASE-ARC-10278-1] c14 N72-21434

**LIGHT TRANSMISSION**
Techniques for measuring and monitoring slant visibility of pilots landing aircraft in fog and haze
[DOT-TSC-FAA-71-25] c02 N72-20998

**LIGHTING EQUIPMENT**
Safe pressurized lighting system for operating in hazardous environments
[NASA-CASE-KSC-10644-1] c09 N72-21250

**LIGHTNING**
Apparatus for determining distance to lightning stroke by sensing magnetic and electric fields
[NASA-CASE-KSC-10698-1] c07 N72-21159
Lightning initiated by human activities
[AD-735917] c13 N72-21392

**LIMESTONE**
Holographic recording of limestone pollution by back or side scattering of ruby laser beam
[PB-205189] c14 N72-21457

**LINE SPECTRA**
Computer program for analyzing single line Mossbauer data
[NASA-TM-X-2522] c24 N72-21677
Analysis of strongest solar ultraviolet emission lines of Mg II, O I, C II, AND C III and atmospheric model development
[NASA-CR-125981] c29 N72-21829

**LINEAR EQUATIONS**
Nonlinear filtering theory used for identification of parameters of linear differential equation model for optimal control applications
[AD-735787] c19 N72-21580
Nonisothermal theory of elastic Cosserat surface and linear equations characterizing initial boundary value problems
[AD-735927] c32 N72-21937

**LINEAR SYSTEMS**
Electromagnetic field equations used for analysis of thrust and lateral forces in single-sided linear induction motors
[PB-205029] c09 N72-21265
Organization of digital computer program for finding root locus of linear, single loop systems
[DLR-FB-71-64] c19 N72-21569

**LIQUID CRYSTALS**
Comparative analysis of flat-panel display technology for fixed format applications including plasma display panels, light emitting diodes, electroluminescent films, liquid crystals, and digital-address flat cathode ray tubes
[AD-735329] c09 N72-21270

**LIQUID FILLED SHELLS**
Application of finite difference and finite element methods for analyzing symmetric fluid oscillations
[DLR-FB-71-69] c12 N72-21316

**LIQUID METAL COOLED REACTORS**
Reactor shielding for fast test and liquid metal fast breeder reactors
[ORNL-TM-3639] c22 N72-21654

**LIQUID METALS**
Thermophysical properties of liquid metals
[AD-735467] c17 N72-21547

**LIQUID OXYGEN**
Nonflammable coatings of synthetic mica and silicate gelant solution mixed with latex paint for use in liquid oxygen or high oxygen gaseous atmospheres
[NASA-CASE-MFS-20486] c18 N72-21557

**LIQUID PHASES**
Study of adsorption kinetics in liquid phase using atomic absorption spectrophotometry
[NASA-TT-F-14263] c14 N72-21425

**LIQUID POTASSIUM**
Effect of nonuniform heat flux along channel length of critical heat flux for boiling potassium in tubes
[BNL-TR-458] c33 N72-21957

**LIQUID ROCKET PROPELLANTS**
Long term storability of liquid rocket propellant tankage
[AD-735288] c27 N72-21811

**LIQUIDS**
Apparatus for mixing two or more liquids under zero gravity conditions
[NASA-CASE-LAR-10195-1] c15 N72-21488
Nucleate boiling heat transfer in binary liquid mixtures, using copper plate and platinum wire
[NLL-LB/G/3091-[9091.9F]] c33 N72-21949

**LITHIUM**
Improved electrolytes and electrodes for rechargeable, nonaqueous lithium batteries
[AD-735269] c03 N72-21036
Very high resolution X ray spectrometry with cooled Si[Li] detectors and optoelectron preamplifier
[CEA-CONF-1840] c14 N72-21439
Application of Compton scattering effect for measuring ground state electronic linear momentum distribution function for lithium and sodium
c26 N72-21746

**LOADS (FORCES)**
Penetrometer for empirically determining load-bearing characteristics of inclined surfaces of remotely located bodies of soil
[NASA-CASE-NPO-11103] c14 N72-21406
Development of procedures for determining strength of cast turbine blades under variable load conditions
[JPRS-55555] c28 N72-21818
Acoustic radiation from free-free, point drive beams affected by light and heavy fluid loading
[AD-735873] c32 N72-21944

**LOGIC CIRCUITS**
Numerical analysis of lower bound for sorting networks based on divide-sort-merge strategy
[AD-735901] c10 N72-21280
Applications of semiconductor diode lasers including use in construction of fast operating logic circuit elements
[AD-735463] c16 N72-21506

**LONG RANGE WEATHER FORECASTING**
Discriminant analysis procedure for predicting quanity of monthly precipitation
[AD-735468] c20 N72-21593
Precise particular solutions to prognostic nonlinear problems for long range weather forecasting
[AD-736485] c20 N72-21623

**LONG TERM EFFECTS**
East-west and north-south polygons for measuring secular variations of gravity field in Czechoslovakia
c13 N72-21336
Annual and secular variations of North Atlantic temperature, based on data for 1881 through 1962
[NLL-M-22214-[5828.4F]] c20 N72-21584
Long term storability of liquid rocket propellant tankage
[AD-735288] c27 N72-21811

**LOOP ANTENNAS**
Radiation characteristics of horizontal loop antenna arrays
[AD-734599] c07 N72-21166

**LORAN**
Navigation/guidance computer requirements for integrated navigation system using combination of outputs of inertial, Doppler, and loran equipment
c08 N72-21224
Application and effectiveness of Kalman filters for loran and inertial navigation systems
[AD-735331] c21 N72-21640

**LORAN C**
Application of airborne digital computers to loran C/D and Omega navigation and guidance systems
c08 N72-21225
Tables on structure and magnitude of loran-C propagation anomaly caused by 100 kHz pulse on isolated terrain
[AD-735680] c21 N72-21638

**LORAN D**
Application of airborne digital computers to loran C/D and Omega navigation and guidance systems
c08 N72-21225

**LOW ALTITUDE**
Low altitude airdrop system using inflation-aided recovery parachutes for extraction
[AD-735375] c02 N72-21013

**LOW GRAVITY MANUFACTURING**
Extraterrestrial manufacturing in orbital workshops, noting applications to drugs, crystal growth, alloys, and optical glass
c31 N72-21897

**LOW SPEED**
Airborne simulator used to determine lateral-directional handling qualities for V/STOL aircraft in low speed maneuvering flight
[AD-735420] c02 N72-21014

**LOW SPEED WIND TUNNELS**
Low speed aerodynamic characteristics of GD/C B-18E3 space shuttle booster
[NASA-CR-120035] c31 N72-21888
German participation in space shuttle design and development including preliminary low speed wind tunnel tests
c31 N72-21898

**LOW TEMPERATURE**
Calculation of one-electron density of state values from low temperature specific heat measurements
c26 N72-21771
Specific heats of hexagonal close-packed erbium and thulium alloys measured in low temperature range between 1.3 and 4.2 K
c26 N72-21773
Measurement of low temperature specific heats of fcc Ru-Rh and Rh-Pd alloys
c26 N72-21774
Densities-of-states at Fermi level of Ti-Mo binary bcc alloys studied using low temperature specific heat augmented by magnetic permeability measurements
c26 N72-21775

**LOW TEMPERATURE PHYSICS**
Methods of carbon isotope separation, thermal diffusion, and low temperature studies
[MLM-1828] c06 N72-21109

**LOWER IONOSPHERE**
Partial reflections of radio waves from lower ionosphere
[NASA-TN-D-6742] c13 N72-21361

**LUBRICANTS**
Journal bearing sectors for lubricant films
[NASA-CASE-LEW-11076-1] c15 N72-21473
Numerical process for analyzing and summarizing fluid viscosity data over extended temperature ranges
[AD-735270] c15 N72-21499

**LUBRICATION**
Analysis of microasperity elastohydrodynamic lubrication of ball spinning in nonconforming groove and comparison with conventional conditions
[NASA-TN-D-6761] c15 N72-21469

**LUMINAIRES**
Electrodeless lamp circuit driven by induction
[NASA-CASE-MFS-21214] c09 N72-21252

**LUMINANCE**
Human visual acuity measured by chromatic square wave gratings under luminance conditions
[AD-734931] c04 N72-21063

**LUMINESCENCE**
Effects of high pressure on spectroscopic properties of aromatic hydrocarbons
[AD-735163] c06 N72-21116
Characteristics of gallium arsenide using either cathode luminescence or trapped electrons
c26 N72-21802
Luminescence and geological analysis of Apollo 14 and 15 lunar soil and rock samples
[NASA-CR-115494] c30 N72-21858
Luminescence analyses of lunar rocks brought back by Apollo 14 and 15
[NASA-CR-115512] c30 N72-21860

**LUNAR CRATERS**
Crater classification and impact explosion origin of small lunar craters
[NASA-TT-F-14177] c30 N72-21867
Statistical analysis of lunar craters to determine relative age of maria
[NASA-TT-F-14178] c30 N72-21868

**LUNAR DUST**
Reaction of simulated lunar dust with fluorine to determine feasibility of oxygen generation
[NASA-TM-X-2533] c06 N72-21098

**LUNAR EXPLORATION**
Lunar exploration by Lunokhod 1 and Luna 17
[NASA-TT-F-14176] c30 N72-21866

**LUNAR MARIA**
Statistical analysis of lunar craters to determine relative age of maria
[NASA-TT-F-14178] c30 N72-21868

**LUNAR MODULE**
Design, development, and qualification of Apollo lunar module reaction control system
[NASA-TN-D-6740] c31 N72-21887

**LUNAR PROBES**
Lunar exploration by Lunokhod 1 and Luna 17
[NASA-TT-F-14176] c30 N72-21866

**LUNAR ROCKS**
High energy gamma photon activation and high resolution gamma ray spectrometry for standard and Apollo 12 rock analysis
[AERE-R-6910] c13 N72-21368
Luminescence and geological analysis of Apollo 14 and 15 lunar soil and rock samples
[NASA-CR-115494] c30 N72-21858
Luminescence analyses of lunar rocks brought back by Apollo 14 and 15
[NASA-CR-115512] c30 N72-21860
Statistical analyses of lunar rock distribution based on Lunokhod 1 data
[NASA-TT-F-14180] c30 N72-21869

**LUNAR SOIL**
Luminescence and geological analysis of Apollo 14 and 15 lunar soil and rock samples
[NASA-CR-115494] c30 N72-21858
Lunar soil samples retrieved by Luna 16 space probe
[NASA-TT-F-13961] c30 N72-21861
Lunar soil samples retrieved by Lunokhod 1
[NASA-TT-F-14181] c30 N72-21865

**LUNIK 16 LUNAR PROBE**
Lunar soil samples retrieved by Luna 16 space probe
[NASA-TT-F-13961] c30 N72-21861

**LUNOKHOD LUNAR ROVING VEHICLES**
Lunar soil samples retrieved by Lunokhod 1
[NASA-TT-F-14181] c30 N72-21865
Lunar exploration by Lunokhod 1 and Luna 17
[NASA-TT-F-14176] c30 N72-21866
Statistical analyses of lunar rock distribution based on Lunokhod 1 data
[NASA-TT-F-14180] c30 N72-21869


## M


**M-2F2 LIFTING BODY**
Wind tunnel tests of M2-F2 lifting body entry configuration at transonic and supersonic speeds and selected Reynolds numbers
[NASA-TM-X-2511] c02 N72-21005

**MACH NUMBER**
Investigation of high Mach number collisionless electrostatic shocks in plasmas
[IPPJ-119] c25 N72-21692

**MACHINE TRANSLATION**
Structure and use of thesaurus for automatic language translation
[NLL-RTS-6886] c34 N72-21965

**MACHINING**
Lathe tool and holder combination for machining resin impregnated fiberglass cloth laminates
[NASA-CASE-XLA-10470] c15 N72-21489

**MAGNESIUM**
Color coded chemical spot test for detecting presence of magnesium and magnesium alloys
[NASA-CASE-LAR-10953-1] c17 N72-21528
Direct and exchange core polarization contributions to spin susceptibility and relation of spin susceptibility and density of states for Mg and Cd
c26 N72-21779

**MAGNESIUM ALLOYS**
Color coded chemical spot test for detecting presence of magnesium and magnesium alloys
[NASA-CASE-LAR-10953-1] c17 N72-21528
Measurement of soft X ray emission spectra for aluminum-magnesium alloys and comparison with spectra for pure metals
c26 N72-21741

**MAGNESIUM CHLORIDES**
Thermodynamics of capillary porous body/liquid system involving graphite, water, and chlorides
c18 N72-21519

**MAGNETIC COILS**
Air-core and iron-core magnets and lenses with windings of finite thickness for accelerators
[BNL-TR-447] c11 N72-21303

**MAGNETIC CORES**
Commutator for steering precisely controlled bidirectional currents through numerous loads by use of magnetic core shift registers
[NASA-CASE-NPO-10743] c08 N72-21199
Air-core and iron-core magnets and lenses with windings of finite thickness for accelerators
[BNL-TR-447] c11 N72-21303

**MAGNETIC EQUATOR**
Penetration of low energy solar protons and alpha particles in interplanetary space and magnetosphere to magnetic equator
c29 N72-21833
Penetration of high energy solar protons to ionospheric heights at magnetic equator
c29 N72-21834

**MAGNETIC FIELDS**
Apparatus for determining distance to lightning stroke by sensing magnetic and electric fields
[NASA-CASE-KSC-10698-1] c07 N72-21159
Effect of earths magnetic field on electromagnetic wave propagation through ionosphere and electron clouds
[AD-735265] c07 N72-21177
Characteristics of circular magnet used as bending magnet for high energy storage rings
[BNL-16299] c11 N72-21301
Magnetic ordering behavior in Cu-Ni alloys as function of Fe and Ni content
[BNL-16276] c17 N72-21540
Quantum cyclotron resonance spectrum of holes in degenerate valence bands of Ge analyzed using concept of critical point in magnetic joint density of states
c26 N72-21756
Knight shifts and temperature dependence in electron density of states of transition metals
c26 N72-21776
Interpretation of absolute Knight shifts of alkalis, variations with pressure, and absolute Knight shifts in binary alkali systems
c26 N72-21778

**MAGNETIC LENSES**
Air-core and iron-core magnets and lenses with windings of finite thickness for accelerators
[BNL-TR-447] c11 N72-21303

**MAGNETIC PERMEABILITY**
Densities-of-states at Fermi level of Ti-Mo binary bcc alloys studied using low temperature specific heat augmented by magnetic permeability measurements
c26 N72-21775
Direct and exchange core polarization contributions to spin susceptibility and relation of spin susceptibility and density of states for Mg and Cd
c26 N72-21779

**MAGNETIC PROPERTIES**
Paleomagnetism, archeomagnetism, magnetic properties of rocks and minerals, and geomagnetic field models
c13 N72-21347

**MAGNETIC RECORDING**
Development of methods for determining coefficient of friction and extent of stick-slip friction of magnetic recording tapes
[NASA-CR-125930] c07 N72-21154

**MAGNETIC STORAGE**
Characteristics of circular magnet used as bending magnet for high energy storage rings
[BNL-16299] c11 N72-21301

**MAGNETIC STORMS**
Ionospheric storm effect comparison over eight oblique sounder paths
[AD-735868] c07 N72-21175

**MAGNETIC TAPES**
Magnetic tapes with ephemeris data for moon and nine planets
[NASA-CR-123595] c30 N72-21857

**MAGNETO-OPTICS**
Derivation of convolution integral expression of optical density of states for k-conserving transitions between broadened levels in crystalline solids
c26 N72-21757

**MAGNETOHYDRODYNAMIC GENERATORS**
Application of explosive driven magnetohydrodynamics for producing pulses at multimegajoule levels
[AD-735660] c15 N72-21497

**MAGNETORESISTIVITY**
Hydrostatic pressure effects on Hall effect and magnetoresistance in graphite crystals with current flow in basal planes
c18 N72-21785

**MAGNETOSPHERE**
Dayside auroral, oval plasma density and conductivity enhancement due to magnetosheath electron precipitation
[NASA-CR-125929] c13 N72-21354
Magnetospheric processes, charged particles, and electric fields
[AD-735149] c13 N72-21388
Penetration of low energy solar protons and alpha particles in interplanetary space and magnetosphere to magnetic equator
c29 N72-21833
Temporal structure of solar protons detected in outer magnetosphere, interplanetary space, at synchronous altitude, and magnetotail
c29 N72-21835
Temporal and spectral changes in access of solar protons and alpha particles to synchronous altitude inside magnetosphere
c29 N72-21836
Solar X-ray and magnetospheric data from OV5-1
[AD-735277] c29 N72-21852
Solar electron and proton measurements in interplanetary space and magnetotail during onset of solar particle event, and comparison with continuous transpolar VLF data
[AD-736430] c29 N72-21855

**MAGNETS**
Characteristics of circular magnet used as bending magnet for high energy storage rings
[BNL-16299] c11 N72-21301

**MAINE**
Thermal parameters for predicting precipitation type for Loring AFB, Maine
[AD-735724] c20 N72-21616

**MAINTENANCE**
Cost/decision model for deferred procurement of Air Force depot maintenance capability with computerized application to F-15 inertial navigation system
[AD-735351] c02 N72-21029
Dynamic programming method for determining optimal repair and replacement policies for Naval aircraft
[AD-736094] c02 N72-21031

**MAN MACHINE SYSTEMS**
Numerical analysis used in computer-aided design and engineering, man computer interactions, computer graphics, and related topics
[AD-735690] c19 N72-21579

**MANAGEMENT PLANNING**
Task, I/O, and configuration management of shuttle flight executive system
[NASA-CR-115514] c08 N72-21205

**MANUAL CONTROL**
Analysis of pedal operation by seated operator with application to design of foot controls for automobiles and other equipment
[AD-735315] c05 N72-21089

**MANUFACTURING**
On-line adaptive controller for drawing and coating of glass rods for resistors
[AD-735154] c15 N72-21500

**MANY BODY PROBLEM**
Statistical mechanical treatment of one-dimensional quantal many body problem noting phase transitions
[NOTA-INTERNA-332] c24 N72-21684

**MAPPING**
Spacecraft transponder and ground station radar system for mapping planetary surfaces
[NASA-CASE-NPO-11001] c07 N72-21118

**MAPS**
Development of automatic process for compiling thematic and general geographic maps
[AD-736481] c13 N72-21402
Orbital and entry tracking accessory mounted on global map to provide range requirements for reentry vehicles to any landing site
[NASA-CASE-LAR-10626-1] c14 N72-21416

**MARINE TECHNOLOGY**
Technical feasibility of assembling large floating structures to provide temporary operational bases on ocean surface
[AD-735491] c11 N72-21306

**MARS PROBES**
Design, development, and characteristics of flight command system for Mariner Mars 1971
[NASA-CR-126038] c31 N72-21891

**MARS 71 PROJECT**
Design, development, and characteristics of flight command system for Mariner Mars 1971
[NASA-CR-126038] c31 N72-21891

**MARTENSITIC STAINLESS STEELS**
Effects of heat treatment, size, specimen type, and test environment on two precipitation-hardened stainless steels during stress corrosion cracking tests
c17 N72-21923

**MASS FLOW**
Small displacement/small strain finite element technique for gravity flow initiation analysis
[PB-205504] c30 N72-21877

**MASS SPECTROMETERS**
High speed scanner for measuring mass of preselected gases at high sampling rate
[NASA-CASE-LAR-10766-1] c14 N72-21432
Digital data acquisition and control for punching mass spectrometer data on IBM cards
[DP-1175] c14 N72-21443

**MASS TRANSFER**
Mathematical flow models and mass transfer
[NLL-RTS-6990] c12 N72-21308
General transport rule for variable mass dynamics for current engineering systems such as rockets, powered space vehicles, jet aircraft, and ablating systems
c19 N72-21570

**MATERIALS**
Ultrahigh frequency references containing materials property data in millimeter and submillimeter ranges
[AD-735621] c09 N72-21269
Stress corrosion cracking in aircraft structures and various materials - historical review
c32 N72-21901

**MATERIALS HANDLING**
Parametric analysis of intravehicular manned cargo transfer in simulated weightlessness
[NASA-TN-D-6774] c05 N72-21075
Effect of double corona charging units on chemistry of materials used in electrostatic printing process
[AD-735369] c15 N72-21491

**MATERIALS RECOVERY**
Computer program for economic analysis of managing high level radioactive wastes from reprocessing power reactor fuels
[ORNL-4633] c22 N72-21648

**MATERIALS TESTS**
Catalog of reports on metallurgy subjects for period 1965 through 1971
[AD-735150] c17 N72-21551

Behavior of ATJ-S graphite under multiaxial stress states
[AD-736470] c18 N72-21565
Standardization of test methods for stress corrosion in metals
c14 N72-21902

MATHEMATICAL MODELS
Mathematical models for determining flight performance of Concorde aircraft
c02 N72-20978
Mathematical models for predicting safety margins in planetary quarantine
[NASA-CR-126032] c04 N72-21050
Mathematical models for analyzing sequential and continuous motor behavior in humans
[AD-734681] c04 N72-21060
Mathematical models for analyzing electromagnetic pulses caused by nuclear weapon burst
[AD-735654] c07 N72-21183
Simulation model for analyzing different computer system configurations
[NASA-CR-61376] c08 N72-21202
Electromagnetic field equations used for analysis of thrust and lateral forces in single-sided linear induction motors
[PB-205029] c09 N72-21265
Mathematical flow models and mass transfer
[NLL-RTS-6990] c12 N72-21308
Turbulent flow model for estimating sound level
[AD-735922] c12 N72-21327
Mathematical models for computing gravity terrain corrections inside and outside circle of 5.26 km radius
c13 N72-21332
Determination of earth figure, and substitution of mathematical model for earth
c13 N72-21344
Analysis of Molodenskii mathematical model of earth figure, and application to test areas in Czechoslovakia
c13 N72-21345
General transport rule for variable mass dynamics for current engineering systems such as rockets, powered space vehicles, jet aircraft, and ablating systems
c19 N72-21570
Quadratic Liapunov functions for vector differential equations in adaptive control system models
[AD-735482] c19 N72-21573
Mathematical models for determining influence of weather forecasts on military operational decisions
[AD-735261] c20 N72-21602
Meteorological data tables predicted by macro-scale baroclinic prediction model
[AD-735737] c20 N72-21610
Meteorological data tables from 1000 mb macro-scale model predictions
[AD-735740] c20 N72-21611
Meteorological data tables from macro-scale cloud model predictions
[AD-735739] c20 N72-21612
Mathematical model of physical properties of density of states of noninteracting electrons moving in static potential of disordered systems
c26 N72-21759
One-dimensional Dirac equation solved for Kronig-Penney model containing delta-potential impurity
c26 N72-21761
Nonlocalization of electron states at middle of continuous band for three dimensional model of tightly bound electrons with cellular disorder
c26 N72-21767
Krafft model for determining susceptibility of Zn-Mg-Cu aluminum alloys to stress corrosion crack growth
c32 N72-21915
Mathematical models of nitrogen oxides in internal combustion engines
[NLL-M-22139-[5828.4F]] c33 N72-21948

MATRICES [MATHEMATICS]
MIMUSA, matrix iteration method of unfolding spectra, using FORTRAN 4 subroutine
[KD/B/N-1962-PT-1] c08 N72-21228
Steady state analysis of open or closed networks consisting of N nodes interconnected by links over which mass flows
[AD-735348] c10 N72-21279
Subroutines for calculation of spin matrix elements of antiproton-neutron annihilation using Zemach relativistic method
[NOTA-INTERNA-328] c24 N72-21683
Antiferromagnetic and paramagnetic states of half-filled narrow energy band investigated using t-matrix method
c26 N72-21768

MATRIX THEORY
T matrix theory of electron states in disordered systems used to determine spectral density for states of various symmetries in beta brass
c26 N72-21765

MEASURING INSTRUMENTS
Measurement of soil moisture content using wire wound strip heater inserted in ground
[NASA-TT-F-14265] c14 N72-21414
Instrument for measuring magnitude and direction of flow velocity in flow field
[NASA-CASE-LAR-10855-1] c14 N72-21417
Mechanically stable, thermally cyclicable point contacts for use in superconducting devices
[AD-735501] c14 N72-21453
Handbook describing ETR instrumentation to obtain data from missile and space flight tests
[AD-735263] c14 N72-21454
Fast response probe to measure density in variable density plane turbulent mixing layer between two different gas streams
[AD-735954] c14 N72-21459
Pumping and metering dual piston system and monitor for reaction chamber constituents
[NASA-CASE-GSC-10218-1] c15 N72-21465

MECHANICAL DEVICES
Mechanical exposure interlock device for preventing film overexposure in oscilloscope camera
[NASA-CASE-LAR-10319-1] c14 N72-21423

MECHANICAL DRIVES
Rotary actuator for use in high vacuum celestial space environments
[NASA-CASE-NPO-10244] c15 N72-21478

MECHANICAL ENGINEERING
Activity report for 1970 on mechanical engineering, metallurgy, metallography, selective dissemination of information, and plastics
c34 N72-21976

MECHANICAL PROPERTIES
Preparation and mechanical properties of austenitic stainless steel weldments
[HEDL-TME-71-118] c15 N72-21490
Strength and deformation properties of heat resistant alloys at high temperatures
[JPRS-55556] c17 N72-21531
Equations of motion for mechanical property determination of sheet metals, using experimental data on diaphragms subjected to transversal shock
[AD-735437] c17 N72-21546
Long term strength of anisotropic composite materials under plane stress
[AD-735434] c18 N72-21560
Mechanical properties and stress corrosion of hot rolled alloy plates
c32 N72-21931

MEDICAL EQUIPMENT
Pressure ramp programmer for automatic blood pressure measurements
[NASA-CR-115508] c05 N72-21074
Portable equipment for detecting myocardial activity
[AD-735882] c05 N72-21084

MERCURY [METAL]
Neutron activation analysis in environmental samples for determination of mercury pollution in Netherlands, noting use of chemical separation method
[IRI-133-71-17] c06 N72-21111

MESH
Grid accelerator system for ion thrustor
[NASA-CASE-XLE-10453-2] c28 N72-21821

MESONS
Positron and electron interactions in omega and phi meson regions at 990 MeV
[LAL-1256] c24 N72-21680

METABOLISM
Mechanism by which inert gases influence metabolism
[NASA-CR-62079] c04 N72-21041
Effects of high altitude on cellular and energy metabolism in rats
[AD-734933] c04 N72-21064

METAL COATINGS
Atmospheric corrosion of metals and metal coatings
[JPRS-55554] c17 N72-21530

METAL COMPOUNDS
Catalog of reports on metallurgy subjects for period 1965 through 1971
[AD-735150] c17 N72-21551

METAL CRYSTALS
Analysis of soft X ray spectra in light metals and development of theory for emission and absorption cancellation effects
c26 N72-21734
Summary and evaluation of trends in electronic density of states conference proceedings
c26 N72-21794

METAL FATIGUE
Ultrahigh vacuum for determining effects of hydrogen on fatigue and fracture properties of Ni 200
c14 N72-21916

METAL OXIDE SEMICONDUCTORS
Gyrator circuit using MOS field effect transistors
[NASA-CASE-MFS-21433] c09 N72-21255

METAL OXIDES
Photofabrication techniques for selective removal of conductive metals oxide coatings from nonconductive substrates
[NASA-CASE-ERC-10108] c06 N72-21094

METAL WORKING
Microstructure and mechanical properties of superalloy produced by gradient-annealing prealloyed powder extrusions
[NASA-TM-X-2545] c17 N72-21527

METALLOGRAPHY
Activity report for 1970 on mechanical engineering, metallurgy, metallography, selective dissemination of information, and plastics
c34 N72-21976

METALLURGY
Activity report for 1970 on mechanical engineering, metallurgy, metallography, selective dissemination of information, and plastics
c34 N72-21976

METALS
Superplastic alloys and metals
[NLL-RTS-6944] c17 N72-21515
Methods for determining types of structural elements occurring during annealing of worked metals
[NLL-RTS-6799] c17 N72-21516
Atmospheric corrosion of metals and metal coatings
[JPRS-55554] c17 N72-21530
Colloidal metallic dispersions and atomic absorption spectrometry
[NASA-TT-F-14232] c17 N72-21536
Premature hydrogen-induced failure in metal systems involving crack initiation, and stable and unstable crack growth
[NASA-TN-D-6691] c17 N72-21537
Nomenclature, stress-strain analysis, and crack propagation in metals
[AD-735700] c17 N72-21550
Standardization of test methods for stress corrosion in metals
c14 N72-21902
Influence of grain size on stress-strain relationship of tensile tested metals
[RAE-LIB-TRANS-1585] c32 N72-21934

METEOROIDS
Role of meteoroids as interplanetary spaceprobes
[NASA-TT-F-13962] c30 N72-21862

METEOROLOGICAL CHARTS
Reference file for aiding weather forecasts at Loredo AFB, Texas
[AD-735791] c20 N72-21615

METEOROLOGICAL INSTRUMENTS
Application of thermistor mass flow rate sensor to aircraft meteorological instruments
[AD-736152] c20 N72-21622

METEOROLOGICAL PARAMETERS
Survey of techniques for determining meteorological data by remote sensing from automatic data buoy platforms
[PB-204793] c14 N72-21452
Machine classification of synoptic processes and meteorological parameters for weather forecasting
[NLL-M-22039-[5828.4F]] c20 N72-21585
Synoptic meteorological data tables of Indias coastal marine areas
[AD-735441] c20 N72-21594
Meteorological data tables for launching Lance missiles
[AD-735361] c20 N72-21595
Meteorological data for Lance launching
[AD-735364] c20 N72-21596
Meteorological parameters for Honest John missile launch
[AD-735362] c20 N72-21597
Synoptic models for studying summer monsoon and diurnal variations of meteorological parameters over Korat Plateau, Thailand
[AD-735283] c20 N72-21600
Meteorological data tables for launching 12804 Lance missile number 2120 round number 137
[AD-735359] c20 N72-21607
Meteorological data tables for launching 11604 Lance missile number 5129 round number 138 RMT
[AD-735360] c20 N72-21608
Meteorological data tables for launching 12806 Lance missile number 2112 round 135
[AD-735358] c20 N72-21617
Meteorological and ballistics data for launching of Lance missile 2105, round 134
[AD-735357] c20 N72-21618
Meteorological data tables for launching 11601 Lance missile number 2171 round 132
[AD-735356] c20 N72-21619
Meteorological data tables for launching 12802 Lance missile number 2132 round 133
[AD-735355] c20 N72-21620
Meteorological data tables for launching Honest John missile number 354, round number 613 RML
[AD-735354] c20 N72-21621

METEOROLOGICAL RADAR
Comparison of simultaneous raindrop and radar pulse integrator observations for rain intensity associated with cold front passage
[NLL-M-22067-[5828.4F]] c20 N72-21588

METEOROLOGICAL SATELLITES
Potential cost reductions in operational ITOS weather satellite program by shuttle/tug availability
[NASA-CR-122398] c31 N72-21895

METEOROLOGY
Meteorology, geomagnetism, auroras, airglow, and ionosphere - bibliography
c34 N72-21974

**MICA**
Nonflammable coatings of synthetic mica and silicate gelant solution mixed with latex paint for use in liquid oxygen or high oxygen gaseous atmospheres
[NASA-CASE-MFS-20486] c18 N72-21557

**MICRODENSITOMETERS**
Analysis of microdensitometer measurements of Apollo 12 photographs of clouds caused by venting liquids into space
[NASA-CR-125934] c31 N72-21885

**MICROELECTRONICS**
Suitability and reliability considerations in plastic encapsulated microcircuit applications
[AD-735500] c09 N72-21261
Military research in microelectronics, chemical lasers, gas lasers, and avionics
[AD-735869] c34 N72-21986

**MICROMETEOROIDS**
Deployable pressurized cell structures for micrometeoroid penetration detector
[NASA-CASE-LAR-10295-1] c15 N72-21472
Origin of Tunguska meteorite, meteoritic fallout, and radio wave studies of meteors
[NLL-M-22218-[5828.4F]] c30 N72-21856

**MICROORGANISMS**
Series analyses method for determining protein content of intact microorganisms
[NASA-TT-F-14253] c04 N72-21042
Portable vacuum surface probe for sampling spacecraft surface for microorganisms
[NASA-CASE-LAR-10623-1] c14 N72-21415

**MICROPHONES**
Microphone array for detection and recording of infrasound
[KGO-TR-71-105] c14 N72-21445

**MICROROCKET ENGINES**
Characteristics of solid propellant rocket engines for delivering high thrust with short impulse duration
[AD-735381] c28 N72-21823

**MICROSTRUCTURE**
Properties of discretely stratified microstructure in Arctic Ocean
[AD-734973] c13 N72-21379
Methods for determining types of structural elements occurring during annealing of worked metals
[NLL-RTS-6799] c17 N72-21516
Microstructure and mechanical properties of superalloy produced by gradient-annealing prealloyed powder extrusions
[NASA-TM-X-2545] c17 N72-21527
Thermomechanical processing to develop various microstructures in nickel and nickel alloys
[NASA-CR-2025] c17 N72-21534
Nitrogen content and microstructure in austenitic stainless steels
[TID-25783] c17 N72-21539
Microstructure and stress corrosion behavior of welded steel joints
c14 N72-21910
Microscopic characteristics of stress corrosion cracking in steel with high yield strength
c32 N72-21925

**MICROWAVE ANTENNAS**
Variable frequency microwave spacecraft antenna
[NASA-CASE-NPO-11264] c07 N72-21155
Development and characteristics of microwave scanning beam approach and landing system phased array antenna
[DOT-TSC-FAA-71-29] c21 N72-21627

**MICROWAVE EQUIPMENT**
Analysis of secure communications capability at millimeter wavelengths and various types of weather conditions
[AD-735686] c07 N72-21168

**MICROWAVE OSCILLATORS**
Microwave-oscillation in gallium arsenide diodes including Gunn effect
[REPT-1891] c26 N72-21801

**MICROWAVE SENSORS**
Anticipatory sensing of impending automobile accidents using microwave radar and ultrasonic sonar
[PB-204806] c14 N72-21449

**MICROWAVE TRANSMISSION**
Scientific research in theoretical plasma, and solid state physics and communication and microwave transmission
[AD-735366] c23 N72-21673

**MICROWAVES**
Bibliography of reported biological responses and clinical manifestations attributed to microwave and radio frequency radiation
[AD-734391] c04 N72-21071

**MIDAIR COLLISIONS**
Numerical analysis of aircraft collision probability due to reduced separation intervals and arbitrary flight paths
[DOT-TSC-FAA-71-27] c02 N72-20997
Economical satellite aided vehicle avoidance system for preventing midair collisions
[NASA-CASE-ERC-10419] c21 N72-21631

**MILITARY AIR FACILITIES**
Cost/decision model for deferred procurement of Air Force depot maintenance capability with computerized application to F-15 inertial navigation system
[AD-735351] c02 N72-21029

**MILITARY AIRCRAFT**
Flight tests to determine suitability of aircraft for operation on aircraft carriers
c02 N72-20988
Flight test procedures for determining turning capability of military aircraft
c02 N72-20989
Mathematical models for determining influence of weather forecasts on military operational decisions
[AD-735261] c20 N72-21602

**MILITARY TECHNOLOGY**
Opportunities in naval research, benefiting both Navy and Marine Corps
[AD-734183] c34 N72-21979
Military research in microelectronics, chemical lasers, gas lasers, and avionics
[AD-735869] c34 N72-21986
Military requirements, criteria, and force structure for Coast Guard search and rescue operations
[AD-735408] c34 N72-21989

**MILKY WAY GALAXY**
Soft X ray survey of galactic plane from Sagittarius to Vela
[UCRL-51090] c30 N72-21872

**MILLIMETER WAVES**
Determination of short pulse, radio frequency burnout properties of crystal diode mixers by application of pulses of controlled amplitude
[AD-735341] c09 N72-21266

**MINERALS**
Paleomagnetism, archeomagnetism, magnetic properties of rocks and minerals, and geomagnetic field models
c13 N72-21347

**MINES [EXCAVATIONS]**
Earth tide observation stations in Czechoslovakian mines equipped with pendulums and inclinometers
c13 N72-21330
Device for detection of combustion light preceding explosion in coal mine
[NASA-CASE-LAR-10739-1] c14 N72-21424

**MINIATURIZATION**
Fast response miniature carbon dioxide detector with no moving parts for measuring concentration in any atmosphere
[NASA-CASE-MSC-13332-1] c14 N72-21408

**MIRRORS**
Optical range finder using reflective first surfaces mirror and transmitting beam splitter
[NASA-CASE-MSC-12105-1] c14 N72-21409
Analysis of mirror wave front distortions caused by Gaussian distributed laser radiation
[AD-735282] c23 N72-21668

**MIS [SEMICONDUCTORS]**
Hydrogenation effects on electron tunneling characteristics of aluminum-oxide-palladium junctions
c26 N72-21789

**MISSILE CONFIGURATIONS**
Aerodynamic characteristics of low aspect ratio, cruciform wing missile model with all-moveable wings and tails at supersonic speed
[NASA-TM-X-2531] c01 N72-20971

**MISSILE RANGES**
Handbook describing ETR instrumentation to obtain data from missile and space flight tests
[AD-735263] c14 N72-21454

**MISSILE TRAJECTORIES**
Design and development of data gathering and reduction system for simulating flight path of guided missile
[AD-736150] c07 N72-21196

**MISSILES**
Adaptive control autopilot for identifying tactical missile
[AD-735488] c31 N72-21899

**MISSION PLANNING**
Summary of Phase A of High Energy Astronomy Observatory Mission-C
[NASA-TM-X-64652-VOL-1] c11 N72-21282
Analysis and conceptual design of baseline mission and spacecraft for HEAO-C
[NASA-TM-X-64652-VOL-2] c11 N72-21283
Supporting technical data, and alternate experiments and spacecraft configurations for HEAO-C
[NASA-TM-X-64652-VOL-3] c11 N72-21284
Project and mission planning for European space programs
c11 N72-21293
Philosophy of network management and spacecraft control at ESOC
c11 N72-21298
Satellite tracking, telemetry, and command network control and procedures noting operating system, data requirements, and orbital elements
c11 N72-21300

**MIXING**
Processes, surfacer reactions, and mixing theory of adhesion
[NLL-RTS-6925] c06 N72-21093

**MODULATION**
Carrier-type transducer with carrier modulation
[NASA-CASE-NUC-10107-1] c09 N72-21254

**MODULUS OF ELASTICITY**
Unified and rational treatment of theory for fiber reinforced composite materials
[NASA-CR-1974] c32 N72-21932

**MOISTURE CONTENT**
Potential application of nuclear measuring techniques for soil density and moisture content at depth
[AD-735448] c13 N72-21395
Measurement of soil moisture content using wire wound strip heater inserted in ground
[NASA-TT-F-14265] c14 N72-21414

**MOLDING MATERIALS**
Process for molding long thin-wall tubular bodies from thermosetting plastic molding compounds
[NASA-CASE-LAR-10782-1] c15 N72-21487

**MOLDS**
Apparatus and method for compression molding of thermosetting plastics
[NASA-CASE-LAR-10489-1] c15 N72-21484
Process for molding long thin-wall tubular bodies from thermosetting plastic molding compounds
[NASA-CASE-LAR-10782-1] c15 N72-21487

**MOLECULAR RELAXATION**
Vibrational relaxation for gaseous mixtures of CO and Ar using rapid heating and cooling rates
[DLR-FB-71-62] c12 N72-21315

**MOLECULES**
Evaluation of Jacobian determinants occurring in classical mechanical and quasiclassical approximation descriptions of molecular scattering
[NASA-CR-125978] c06 N72-21095

**MOLTEN SALT ELECTROLYTES**
Redox equilibria, thermodynamic properties of aqueous systems, and electrochemistry of aqueous systems and molten salts
[STU-68-261-U-208] c17 N72-21542

**MOLYBDENUM**
Effect of tungsten and molybdenum on softening and structure of chromium-nickel austenitic stainless steel
[AD-735466] c17 N72-21548
Thermodynamic properties of tungsten, niobium, and molybdenum
[AD-736039] c17 N72-21553
Photoemission and optical measurement studies of electronic structure of vapor deposited molybdenum films
[NASA-CR-126041] c26 N72-21727

**MOLYBDENUM ALLOYS**
Thermal stability of molybdenum alloy, low alloy steel production and economics, and improving sound metal yield in cast and rolled products
[NLL-M-21286-[5828.4F]] c17 N72-21514
Effects of high transition elements on hardness of Mo alloys
[NASA-TM-X-68028] c17 N72-21525
Densities-of-states at Fermi level of Ti-Mo binary bcc alloys studied using low temperature specific heat augmented by magnetic permeability measurements
c26 N72-21775

**MOMENTS OF INERTIA**
Development of techniques and equipment for determining moment of inertia of aircraft as applied to A-37 and P-1127 aircraft
[FTC-TIM-71-1001] c02 N72-21007

**MOMENTUM TRANSFER**
Pion exchange processes for elementary pion with transverse momentum cut-off
[NOTA-INTERNA-342] c24 N72-21687

**MONITORS**
Instruments for measuring air pollution emmitted by aircraft engines
[PB-204794] c20 N72-21592

**MONOCHROMATIC RADIATION**
Method and apparatus for producing intense, coherent, monochromatic light from low temperature plasma
[NASA-CASE-XNP-04167-3] c25 N72-21693

**MONSOONS**
Synoptic models for studying summer monsoon and diurnal variations of meteorological parameters over Korat Plateau, Thailand
[AD-735283] c20 N72-21600

**MOON**
Magnetic tapes with ephemeris data for moon and nine planets
[NASA-CR-123595] c30 N72-21857

**MORPHOLOGY**
Ionograms and morphological statistics of polar slant E condition, emphasizing two stream or plasma ion wave instability
c07 N72-21148

**MOSSBAUER EFFECT**
Neutron diffraction and Mossbauer studies of hexagonal linear chain compound, RbFeCl3
[BNL-16327] c06 N72-21106
Magnetic hyperfine structure and Mossbauer effect in rubidium and potassium fluorides
[BNL-16326] c06 N72-21107
Computer program for analyzing single line Mossbauer data
[NASA-TM-X-2522] c24 N72-21677

**MOTION**
Methods of measuring vehicle occupant motion during crash or impact and evaluation of restraint system performance
[PB-204809] c14 N72-21447

Analysis of methods for measuring vehicle occupant motion during crash or impact and evaluation of restraint system performance
[PB-204808] c14 N72-21448

MOTION PICTURES
Motion picture test for air traffic control aptitude for use in personnel selection and evaluation
[AD-735942] c05 N72-21085

MOUNTAINS
Tables on structure and magnitude of loran-C propagation anomaly caused by 100 kHz pulse on isolated terrain
[AD-735680] c21 N72-21638

MULTICHANNEL COMMUNICATION
Recommendations for changes in Federal Communication rules governing Citizens Radio Service
[PB-204595] c07 N72-21190
Multichannel pneumoacoustic control system for open drive
[AD-735234] c15 N72-21495

MULTIPLEXING
Resonators for diplexers in multiplexing network noting bandpass filters and coplanar waveguides
[ESRO-CR-46] c07 N72-21164

MULTIPLIERS
Method of multipliers for constrained minimization in relation to ordinary and conjugate gradient algorithms
[PB-205311] c19 N72-21575
Function minimization for computer programming using modification of multipliers
[PB-205312] c19 N72-21576

MULTIVARIATE STATISTICAL ANALYSIS
Statistical methods for solving forecasting and control theory problems
[AD-735197] c19 N72-21578

MUONS
Muon pair production by electron-positron annihilation at energies up to 2.1 GeV
[NOTA-INTERNA-336] c24 N72-21689
Daily diurnal and semidiurnal variation vectors for cosmic ray muon and neutron monitors
[AECL-4059] c29 N72-21850

MUSCULAR FATIGUE
Electromyographic measurement of maximum voluntary muscle contraction endurance in chronic hyperventilators
[AD-734298] c04 N72-21072

## N

N-TYPE SEMICONDUCTORS
Influence of fast neutron bombardment on transport properties of carriers in n-type germanium
[ORO-3651-10] c24 N72-21679
Metal-semiconductor barrier junction tunneling study of heavily doped n-type silicon density of states function
c26 N72-21784
Transport properties of n-type alloys of GaP and ZnSe and their application to luminescent diodes
[NASA-CR-111997] c26 N72-21798

NAVIGATION AIDS
Development of automatic process for compiling thematic and general geographic maps
[AD-736481] c13 N72-21402

NAVIGATION INSTRUMENTS
Development of system for position location reporting and control of tactical aircraft using recursive navigation program
[AD-735262] c21 N72-21636

NAVIGATION SATELLITES
Capability of navigation satellite system for predicting ionospheric conditions for optimum transmitting parameters in high frequency sky wave telecommunication
[AD-735866] c07 N72-21174
Selection of computers for satellite based navigation and guidance system designed for aircraft users
c08 N72-21226
Development of technique for increasing accuracy of Omega navigation system
[AD-735372] c21 N72-21635

NAVIGATORS
French school for training navigation personnel
c11 N72-20993

NAVY
Opportunities in naval research, benefiting both Navy and Marine Corps
[AD-734183] c34 N72-21979

NERVOUS SYSTEM
Clinical analysis of hypokinesia caused changes in nervous system and effects of pharmocological preparations on hypokinesia disorders
[NASA-TT-F-14225] c04 N72-21046

NETHERLANDS
Neutron activation analysis in environmental samples for determination of mercury pollution in Netherlands, noting use of chemical separation method
[IRI-133-71-17] c06 N72-21111

NETWORK ANALYSIS
Signal detection, communication theory, parameter estimation, and network analysis
[AD-735760] c07 N72-21181
Positive and negative feedback networks insensitive to variations in amplifier gains
[SCL-DR-710094] c10 N72-21277
Steady state analysis of open or closed networks consisting of N nodes interconnected by links over which mass flows
[AD-735348] c10 N72-21279
Philosophy of network management and spacecraft control at ESOC
c11 N72-21298
Satellite tracking, telemetry, and command network control and procedures noting operating system, data requirements, and orbital elements
c11 N72-21300

NETWORK SYNTHESIS
Numerical analysis of lower bound for sorting networks based on divide-sort-merge strategy
[AD-735901] c10 N72-21280

NEUROMUSCULAR TRANSMISSION
Electromyographic measurement of maximum voluntary muscle contraction endurance in chronic hyperventilators
[AD-734298] c04 N72-21072

NEUTRON ACTIVATION ANALYSIS
Neutron activation analysis in environmental samples for determination of mercury pollution in Netherlands, noting use of chemical separation method
[IRI-133-71-17] c06 N72-21111

NEUTRON DIFFRACTION
Neutron diffraction and Mossbauer studies of hexagonal linear chain compound, RbFeCl3
[BNL-16327] c06 N72-21106
Lattice structure of Nb4N3 based on neutron diffraction analysis
c06 N72-21524

NEUTRON IRRADIATION
Influence of fast neutron bombardment on transport properties of carriers in n-type germanium
[ORO-3651-10] c24 N72-21679

NEUTRONS
Position sensitive proportional counter for neutron imaging applications
[BNWL-SA-3936] c14 N72-21441
Tabulated uncorrected and barometer-corrected cosmic ray neutron monitor data
[AECL-4060] c29 N72-21849
Daily diurnal and semidiurnal variation vectors for cosmic ray muon and neutron monitors
[AECL-4059] c29 N72-21850

NICKEL
Interaction and marginal wetting angles of chromium and titanium borides with iron and nickel
c17 N72-21518
Thermomechanical processing to develop various microstructures in nickel and nickel alloys
[NASA-CR-2025] c17 N72-21534
Ultrahigh vacuum for determining effects of hydrogen on fatigue and fracture properties of Ni 200
c14 N72-21916

NICKEL ALLOYS
Pack process for introducing alumina into solid solution near surface of thoriated nickel-chromium alloys
[NASA-CR-120880] c17 N72-21526
Dispersion strengthened nickel-alumina alloy produced by comminution and blending
[NASA-TM-X-2548] c17 N72-21533
Thermomechanical processing to develop various microstructures in nickel and nickel alloys
[NASA-CR-2025] c17 N72-21534
Magnetic ordering behavior in Cu-Ni alloys as function of Fe and Ni content
[BNL-16276] c17 N72-21540

NIMBUS 4 SATELLITE
Development and characteristics of balloon interrogation package for use with Nimbus 4 satellite
[NASA-CR-122375] c14 N72-21410

NIOBIUM
Solubility of carbon in niobium
c18 N72-21523
Thermodynamic properties of tungsten, niobium, and molybdenum
[AD-736039] c17 N72-21553

NIOBIUM COMPOUNDS
Lattice structure of Nb4N3 based on neutron diffraction analysis
c06 N72-21524

NITRIDES
Nitride production utilizing plasma jets
[NLL-RTS-6884] c06 N72-21092
Lattice structure of Nb4N3 based on neutron diffraction analysis
c06 N72-21524

NITROGEN
Nitrogen content and microstructure in austenitic stainless steels
[TID-25783] c17 N72-21539

NITROGEN OXIDES
Coulometric measurement of micro-impurities of nitrogen oxide, sulfur dioxide, and ammonia in gases
[NLL-M-22138-[5828.4F]] c14 N72-21404
Mathematical models of nitrogen oxides in internal combustion engines
[NLL-M-22139-[5828.4F]] c33 N72-21948

NOBLE METALS
Nonrelativistic KKR calculations of Fermi surface properties of Cu, Ag, and Au at normal volume as function of pressure
c26 N72-21711
Electron density of states for noble and transition metals by X ray photoelectron spectroscopy
c26 N72-21722

NOISE REDUCTION
Aircraft noise reduction by extinction with reversed phase sound in acoustic interference
[MBB-BB-55-71-O] c02 N72-21011

NONFERROUS METALS
Thermodynamic and solid solution studies of nonferrous metallic compounds
[JPRS-55392] c17 N72-21517

NONFLAMMABLE MATERIALS
Nonflammable coatings of synthetic mica and silicate gelant solution mixed with latex paint for use in liquid oxygen or high oxygen gaseous atmospheres
[NASA-CASE-MFS-20486] c18 N72-21557

NONLINEAR EQUATIONS
Precise particular solutions to prognostic nonlinear problems for long range weather forecasting
[AD-736485] c20 N72-21623

NONLINEAR FILTERS
Nonlinear filtering theory used for identification of parameters of linear differential equation model for optimal control applications
[AD-735787] c19 N72-21580

NONLINEAR SYSTEMS
Two computer algorithms for obtaining periodic response of nonlinear circuits
[AD-735713] c08 N72-21232

NONLINEARITY
Nonlinear analysis of plates considering geometric and material effects, including large deflections
[AD-735937] c32 N72-21938

NORTH ATLANTIC TREATY ORGANIZATION [NATO]
AGARD 1972 meetings, 1971 publications, and 1972 membership
[AGARD-BULL-72-1] c34 N72-21973

NOTCH SENSITIVITY
Notch sensitivity of various steels and alloys used in reactor materials after irradiation
[AD-735872] c22 N72-21659
Cantilever bending tests for determining susceptibility of high strength alloys to stress corrosion cracking
c14 N72-21911

NOZZLE DESIGN
Design problems of inlets and nozzles used in supersonic and V/STOL propulsion systems
[NASA-TM-X-67741] c28 N72-21819

NUCLEAR ENERGY
Effects of radioactive wastes from nuclear power generation on environment
[CONF-711113-2] c22 N72-21658

NUCLEAR EXPLOSIONS
Mathematical models for analyzing electromagnetic pulses caused by nuclear weapon burst
[AD-735654] c07 N72-21183
Case histories of international cooperation in field of ballistic ranges, sonic boom generators and simulation of nuclear blast in galleries
[ISL-4/71] c11 N72-21304
Computer programs for elastic wave propagation code to analyze ground motions from vertically oriented nuclear detonations
[NVO-1163-227] c13 N72-21371

NUCLEAR FUELS
Computer program for economic analysis of managing high level radioactive wastes from reprocessing power reactor fuels
[ORNL-4633] c22 N72-21648
Momentum and heat transfer in turbulent flow of air in fuel assembly model
[ZJE-111] c22 N72-21651

NUCLEAR RADIATION
Potential application of nuclear measuring techniques for soil density and moisture content at depth
[AD-735448] c13 N72-21395

NUCLEAR REACTIONS
Application of position-sensitive semiconductor detectors to study heavy element nuclear reactions at intermediate energies
[MNC-3783-10] c14 N72-21442

NUCLEAR STRUCTURE
Benormalization of light nuclei based on Coulomb potential differences
[NOTA-INTERNA-344-PT-1] c24 N72-21685

NUCLEAR WEAPONS
Mathematical models for analyzing electromagnetic pulses caused by nuclear weapon burst
[AD-735654] c07 N72-21183

NUCLEATE BOILING
Nucleate boiling heat transfer in binary liquid mixtures, using copper plate and platinum wire
[NLL-LB/G/3091-[9091.9F]] c33 N72-21949

**NUCLEI [NUCLEAR PHYSICS]**
Benormalization of light nuclei based on Coulomb potential differences
[NOTA-INTERNA-344-PT-1] c24 N72-21685
**NULL ZONES**
Detection and control of radiation pattern nulls in phased arrays
[AD-735653] c07 N72-21179
**NUMERICAL ANALYSIS**
Development of numerical process for extracting aerodynamic coefficients from flight test data
c19 N72-20991
Theoretical basis and application of computer-aided curve fit and analysis program
[AD-735946] c08 N72-21230
Numerical analysis of electron flow in high current megavolt diodes with aid of computer program
[AD-735498] c09 N72-21262
Implicit finite difference scheme for numerical integration of equations governing hypersonic slipflow-boundary layers
[DLR-FB-71-97] c12 N72-21317
Using two-dimensional Lagrangian code to computer growth of perturbed interface between perfect gas and aluminum
[LA-4754] c12 N72-21319
Numerical analysis of cone angle effects on penetration resistance in soils
[AD-735788] c14 N72-21460
Method for numerically solving class of two-point boundary value problems in optimal control theory
[NASA-TM-X-58088] c19 N72-21567
Convergence of discretization equations in numerical analysis of degenerate partial differential equations of stochastic control theory
[NASA-CR-126037] c19 N72-21568
Numerical analysis used in computer-aided design and engineering, man computer interactions, computer graphics, and related topics
[AD-735690] c19 N72-21579
Numerical analysis of density conditions necessary for production of phase transition in solids
c26 N72-21750
**NUMERICAL WEATHER FORECASTING**
Assimilation of 4-dimensional meteorological data in objective forecasting model
[NLL-M-22063-[5828.4F]] c20 N72-21587
Discriminant analysis procedure for predicting quanity of monthly precipitation
[AD-735468] c20 N72-21593
Denmark and Finland research on use of orthogonal functions and spectral method to predict weather
[AD-735896] c20 N72-21605
Macroscale update weather forecast model for numerical hemispheric forecasts
[AD-735742] c20 N72-21606
Meteorological data tables predicted by macro-scale baroclinic prediction model
[AD-735737] c20 N72-21610
Meteorological data tables from 1000 mb macro-scale model predictions
[AD-735740] c20 N72-21611
Meteorological data tables from macro-scale cloud model predictions
[AD-735739] c20 N72-21612
Weather forecast tables as predicted by limited area mesoscale prediction model
[AD-735738] c20 N72-21613
Thermal parameters for predicting precipitation type for Loring AFB, Maine
[AD-735724] c20 N72-21616
Correctness of problem with initial conditions for partial differential equation in numerical weather forecasting
[AD-735507] c34 N72-21981


## O


**OCEAN BOTTOM**
Bathymetric chart of Carmel Bay
[AD-734986] c13 N72-21380
**OCEAN CURRENTS**
Transport float and hydrographic station data from three transects of Gulf Stream between Cape Cod and Bermuda
[AD-734419] c13 N72-21374
**OCEAN SURFACE**
Technical feasibility of assembling large floating structures to provide temporary operational bases on ocean surface
[AD-735491] c11 N72-21306
**OCEANOGRAPHY**
Oceanographic and climatic influence on Indian Ocean thermal structures in upper layers
[AD-734668] c13 N72-21378
Geomagnetism, satellite tracking, oceanography, hyperbolic navigation, and radio equipment research projects
[AD-735169] c21 N72-21639
**ODORS**
Effects of atmospheric odorous exposure on community health and annoyance reactions
[PB-204989] c20 N72-21598
**OMEGA NAVIGATION SYSTEM**
Application of airborne digital computers to loran C/D and Omega navigation and guidance systems
c08 N72-21225
Development of technique for increasing accuracy of Omega navigation system
[AD-735372] c21 N72-21635
**OMNIDIRECTIONAL ANTENNAS**
Design, development, and evaluation of low silhouette, portable, high frequency antenna for ground to ground communication
[AD-735679] c07 N72-21172
Vertically stacked collinear array of independently fed omnidirectional antennas for use in collision warning systems on commercial aircraft
[NASA-CASE-LAR-10545-1] c09 N72-21244
**ON-LINE PROGRAMMING**
On-line, graphic input-output systems
[NASA-CR-126036] c08 N72-21208
On-line adaptive controller for drawing and coating of glass rods for resistors
[AD-735154] c15 N72-21500
**ONE DIMENSIONAL FLOW**
Numerical analysis of one dimensional momentum flux and comparison with experimental value for range of two phase flow conditions
[NASA-TM-X-68038] c12 N72-21311
**OPERATIONS RESEARCH**
Evaluation of computerized simulation technique for developing search and rescue operational effectiveness
[AD-735418] c11 N72-21305
Application of distribution functions and stochastic processes to determine production capability of series of work stations with variable service times
[AD-735363] c15 N72-21498
**OPERATORS [MATHEMATICS]**
Measuring noncommuting operators in quantum detection and estimation theory
[NASA-CR-122364] c24 N72-21675
**OPTICAL DATA PROCESSING**
Optical data processing system using paraboloidal reflecting surfaces
[NASA-CASE-GSC-11296-1] c23 N72-21662
Radiation effects on properties of photochromic materials incorporated in plastics and used in holography and other optical data processing methods
[LCR-DR-70-90/1/R] c23 N72-21664
**OPTICAL DENSITY**
Ocular laser protective filter with narrowband absorption, luminous transmission, and optical density of 3.5
[AD-735799] c05 N72-21083
Derivation of convolution integral expression of optical density of states for k-conserving transitions between broadened levels in crystalline solids
c26 N72-21757
**OPTICAL EMISSION SPECTROSCOPY**
Ultraviolet photoemission methods of determining density of valence and conduction states
[NASA-CR-126040] c26 N72-21720
Structure of d-band for Sc, Ti and Zr in 4 to 11.6 eV range by photoemission spectroscopy
c26 N72-21726
**OPTICAL FILTERS**
Ocular laser protective filter with narrowband absorption, luminous transmission, and optical density of 3.5
[AD-735799] c05 N72-21083
Family of physical correction filters for improving optical quality of image
[NASA-CASE-HQN-10542-1] c23 N72-21663
**OPTICAL MEASUREMENT**
Photoemission and optical measurement studies of electronic structure of vapor deposited molybdenum films
[NASA-CR-126041] c26 N72-21727
**OPTICAL MEASURING INSTRUMENTS**
Optical distance measuring device and field testing
[AD-735235] c13 N72-21385
Optical sensing of supersonic flows by correlating deflections in laser beams through flow
[NASA-CASE-MFS-20642] c14 N72-21407
Low light image recording system for recording data from optical telescopes
[AD-735830] c23 N72-21669
**OPTICAL PROPERTIES**
Test methods for determining optical properties of neodymium-doped glass and ruby
[UCRL-73478] c16 N72-21504
Pre- and post-irradiation electrical and optical properties of Ga As laser diodes
[AD-735939] c16 N72-21507
Radiation effects on properties of photochromic materials incorporated in plastics and used in holography and other optical data processing methods
[LCR-DR-70-90/1/R] c23 N72-21664
Papers presented at conference on electronic density of states in solids and liquids
[NBS-SP-323] c26 N72-21702
Electronic band structures and densities of states for two intermetallic compounds having CsCl structure
c26 N72-21704
Using Ashcroft energy band model representation of measured Fermi surface for calculating optical properties of aluminum
c17 N72-21706
Infrared reflectivity of arsenic correlated with Fermi surface, magnetoreflection and optical reflectivity measurements
c18 N72-21707
Parametrization techniques used for obtaining band structure for density of state calculations
c26 N72-21713
Correlating electronic energy bands of tetragonal GeO2 with optical properties
c26 N72-21716
Calculating density of states and optical properties of PbTe from augmented plane wave and linear combination of atomic orbital energy bands
c26 N72-21717
Summary and evaluation of trends in electronic density of states conference proceedings
c26 N72-21794
**OPTICAL RADAR**
Remote detection of fog banks using lidar backscattering and infrared radiometry
[PB-204805] c14 N72-21451
**OPTICAL RANGE FINDERS**
Optical range finder using reflective first surfaces mirror and transmitting beam splitter
[NASA-CASE-MSC-12105-1] c14 N72-21409
**OPTICS**
Computer program for analysis of general optical systems
[AD-735674] c16 N72-21510
**OPTIMAL CONTROL**
Optimal control algorithms for on-line closed loop blood pressure regulation
[AD-735900] c05 N72-21088
Method for numerically solving class of two-point boundary value problems in optimal control theory
[NASA-TM-X-58088] c19 N72-21567
Optimal control problems with lags
[AD-735475] c19 N72-21572
Nonlinear filtering theory used for identification of parameters of linear differential equation model for optimal control applications
[AD-735787] c19 N72-21580
**OPTIMIZATION**
Method of multipliers for constrained minimization in relation to ordinary and conjugate gradient algorithms
[PB-205311] c19 N72-21575
Function minimization for computer programming using modification of multipliers
[PB-205312] c19 N72-21576
Numerical analysis of parameters in multistage gas turbine engines and components
[AD-736489] c28 N72-21827
**ORBITAL ELEMENTS**
Geoid and gravity data based on satellite orbital elements
c13 N72-21333
**ORBITAL WORKERS**
Crew facilities and operations for modular space stations
[NASA-CR-121087] c31 N72-21883
**ORBITAL WORKSHOPS**
Extraterrestrial manufacturing in orbital workshops, noting applications to drugs, crystal growth, alloys, and optical glass
c31 N72-21897
**ORDER-DISORDER TRANSFORMATIONS**
Influence of generalized order-disorder on electron states for various types of binary intermetallic compounds
c26 N72-21762
**OROGRAPHY**
Winter orographic cloud modification seeding experiment in Colorado mountains
[PB-205277-F] c20 N72-21599
**ORTHOGONAL FUNCTIONS**
Denmark and Finland research on use of orthogonal functions and spectral method to predict weather
[AD-735896] c20 N72-21605
**OSCILLATIONS**
Application of finite difference and finite element methods for analyzing symmetric fluid oscillations
[DLR-FB-71-69] c12 N72-21316
Numerical analysis of oscillatory aerodynamic forces and moments acting on cascade of airfoils in unstalled conditions
[AD-735205] c28 N72-21825
Planetary resonance structure, sunspot activity, and bistable modes of solar oscillation
[NASA-CR-2035] c30 N72-21870
**OSCILLOSCOPES**
Mechanical exposure interlock device for preventing film overexposure in oscilloscope camera
[NASA-CASE-LAR-10319-1] c14 N72-21423
**OV-1 SATELLITES**
Solar X-ray and magnetospheric data from OV5-1
[AD-735277] c29 N72-21852
**OXIDATION**
Valve sealing performance in fluorinated oxidizers
[AD-735286] c15 N72-21494

**OXIDES**
Polycrystalline oxide ceramic development, densification and porosity change kinetics, and Nd doped yttrium oxide rods as laser material
[AD-736223] c16 N72-21513

**OXYGEN**
Reaction of simulated lunar dust with fluorine to determine feasibility of oxygen generation
[NASA-TM-X-2533] c06 N72-21098
Method for detecting oxygen in gas by thermoluminescence
[NASA-CASE-LAR-10668-1] c06 N72-21103
Oxygen effects in static sodium on vanadium and vanadium alloys, using internal oxygen theory
[ORNL-4739] c06 N72-21108
Vacuum ultraviolet multiplets for ionized carbon and oxygen, and absolute emission cross sections
[NASA-TM-X-65864] c24 N72-21676

**OXYGEN ANALYZERS**
Evaluation of oxygen-sensing warning device for use in damage control suit system
[AD-735377] c05 N72-21082

**OXYGEN CONSUMPTION**
Response of ventilation parameters, pulse rate, oxygen uptake, and body temperature in man under acute and severe hypoxia
[DLR-FB-71-65] c04 N72-21053

**OXYGEN FLUORIDES**
Oxygen difluoride in synthesis of fluoropolymers
[NASA-CASE-NPO-12061-1] c06 N72-21100

**OXYGEN ISOTOPES**
Isotope exchange of C[O-18] and C[O-16]2 with O dissolved in metal for volumetric and surface analysis
[NASA-TT-F-14148] c16 N72-21501


## P


**P WAVES**
Amplitude epicenter distance curves of P and S waves used to determine upper mantle structure of Southeastern Europe
c13 N72-21338

**P-1127 AIRCRAFT**
Stability and control flight test procedures for V/STOL aircraft in general and specific application to P-1127 and Harrier aircraft
c02 N72-20980
Development of techniques and equipment for determining moment of inertia of aircraft as applied to A-37 and P-1127 aircraft
[FTC-TIM-71-1001] c02 N72-21007

**PACIFIC OCEAN**
Free air gravity and computed free air anomalies obtained along 150 deg meridian
[AD-735114] c13 N72-21375

**PAINTS**
Nonflammable coatings of synthetic mica and silicate gelant solution mixed with latex paint for use in liquid oxygen or high oxygen gaseous atmospheres
[NASA-CASE-MFS-20486] c18 N72-21557

**PAIR PRODUCTION**
Muon pair production by electron-positron annihilation at energies up to 2.1 GeV
[NOTA-INTERNA-336] c24 N72-21689

**PALEOMAGNETISM**
Paleomagnetism, archeomagnetism, magnetic properties of rocks and minerals, and geomagnetic field models
c13 N72-21347

**PALLADIUM**
Energy distribution of optically excited electrons in Pd arising from direct interband transitions assuming constant momentum matrix elements
c26 N72-21723
Hydrogenation effects on electron tunneling characteristics of aluminum-oxide-palladium junctions
c26 N72-21789

**PALLADIUM ALLOYS**
Hydrogenation unit with reaction chamber of hydrogen-permeable palladium alloy
[NASA-CASE-NPO-11682] c15 N72-21474
Measurement of low temperature specific heats of fcc Ru-Rh and Rh-Pd alloys
c26 N72-21774
Electrical resistivity changes in gold-palladium alloys during hydrogen absorption
c26 N72-21786

**PARABOLOID MIRRORS**
Optical data processing system using paraboloidal reflecting surfaces
[NASA-CASE-GSC-11296-1] c23 N72-21662

**PARACHUTE FABRICS**
Development and characteristics of parachute fabric for aerodynamic decelerator using lightweight, variable solidity, knitted material
[NASA-CASE-LAR-10776-1] c02 N72-21004

**PARAMAGNETISM**
Antiferromagnetic and paramagnetic states of half-filled narrow energy band investigated using t-matrix method
c26 N72-21768
Pauli paramagnetic susceptibility in metals and alloys with high electron density of state
c26 N72-21777

**PARTIAL DIFFERENTIAL EQUATIONS**
Precise particular solutions to prognostic nonlinear problems for long range weather forecasting
[AD-736485] c20 N72-21623
Correctness of problem with initial conditions for partial differential equation in numerical weather forecasting
[AD-735507] c34 N72-21981

**PARTIAL PRESSURE**
Computer program for calculating partial pressure of selected gases from residual gas analyzer ion spectra
[NASA-CR-125938] c06 N72-21096

**PARTICLE COLLISIONS**
Electron-positron storage rings noting QED, vector meson, and hadronic experiments
[NOTA-INTERNA-343] c24 N72-21686

**PARTICLE PRODUCTION**
Ultrahigh energy cosmic ray attenuation due to hadron production
[RIFP-142] c29 N72-21830

**PARTICLE SIZE DISTRIBUTION**
Radiation measurements for determination of atmospheric dust particle concentration
[ISL-6/71] c13 N72-21373

**PARTICLES**
Particle precipitation in polar upper atmosphere
c07 N72-21122
Calculation of density of electron levels for small particles using diffusion equation
c26 N72-21760
Data reduction for concentration measurements of solid particles in space
[NASA-TT-F-14188] c30 N72-21864

**PASSENGER AIRCRAFT**
Simulation of turnaround operation of passenger aircraft using critical path method for improving aircraft/terminal utilization
c34 N72-21970

**PATTERN RECOGNITION**
Evaluation of pattern-matching speech bandwidth compression techniques used with voice data processor system
[AD-735308] c07 N72-21189
Waveform processing system as flexible on-line graphic interactive tool for signal classification
[AD-735749] c08 N72-21241

**PAULI EXCLUSION PRINCIPLE**
Pauli paramagnetic susceptibility in metals and alloys with high electron density of state
c26 N72-21777

**PCM TELEMETRY**
High speed direct binary to binary coded decimal converter for use in PCM telemetry systems
[NASA-CASE-KSC-10326] c08 N72-21197
Satellite control noting CNES ground station network
c11 N72-21297

**PEDALS**
Analysis of pedal operation by seated operator with application to design of foot controls for automobiles and other equipment
[AD-735315] c05 N72-21089

**PENETROMETERS**
Penetrometer for empirically determining load-bearing characteristics of inclined surfaces of remotely located bodies of soil
[NASA-CASE-NPO-11103] c14 N72-21406
Numerical analysis of cone angle effects on penetration resistance in soils
[AD-735788] c14 N72-21460

**PERFLUORO COMPOUNDS**
Process for preparing disilanols with in-chain perfluoroalkyl groups
[NASA-CASE-MFS-20979-2] c06 N72-21101

**PERFORMANCE PREDICTION**
Role of air cargo in Canadian transportation for period 1967 to 1987
c34 N72-21969

**PERFORMANCE TESTS**
Development of techniques for evaluating performance of air breathing engines and measurement of significant operating parameters
[NASA-TM-X-68305] c28 N72-20983
Flight tests to determine suitability of aircraft for operation on aircraft carriers
c02 N72-20988
Apparatus and method for quantitatively determining performance of linear explosives, mild detonating fuze, and flexible linear shaped charges
[NASA-CASE-LAR-10800-1] c33 N72-21955

**PERSONNEL SELECTION**
Anthropometric requirements for entrance into naval flight training program
[AD-735101] c04 N72-21067
Motion picture test for air traffic control aptitude for use in personnel selection and evaluation
[AD-735942] c05 N72-21085

**PERTURBATION THEORY**
Using two-dimensional Lagrangian code to computer growth of perturbed interface between perfect gas and aluminum
[LA-4754] c12 N72-21319

**PH**
Microelectrodes for measuring pH gradients during stress corrosion of aluminum alloys and 1020 steel exposed to potassium chloride
c17 N72-21909

**PHARMACOLOGY**
Clinical analysis of hypokinesia caused changes in nervous system and effects of pharmocological preparations on hypokinesia disorders
[NASA-TT-F-14225] c04 N72-21046

**PHASE DETECTORS**
Bit detection methods and detectors for FSK and PSK modulated data
c07 N72-21294

**PHASE MODULATION**
Transmitter receiver system for Helios solar probe using coherent phase modulation
c07 N72-21162

**PHASE SHIFT KEYING**
Bit detection methods and detectors for FSK and PSK modulated data
c07 N72-21294

**PHASE TRANSFORMATIONS**
Effect of titanium concentration on structure and temperature of brittle-ductile transition in alloys of Cr-Ti-V-B system
c17 N72-21522
Statistical mechanical treatment of one-dimensional quantal many body problem noting phase transitions
[NOTA-INTERNA-332] c24 N72-21684
Numerical analysis of density conditions necessary for production of phase transition in solids
c26 N72-21750
Density of states curves used to obtain thermodynamic information associated with allotropic phase transitions in bcc and fcc iron
c26 N72-21790

**PHASED ARRAYS**
Detection and control of radiation pattern nulls in phased arrays
[AD-735653] c07 N72-21179
Ray tracing method used to evaluate scanning capabilities of offset-feed near-field Gregorian antenna excited with planar array
[AD-736029] c07 N72-21193
Development and characteristics of microwave scanning beam approach and landing system phased array antenna
[DOT-TSC-FAA-71-29] c21 N72-21627

**PHONETICS**
Design, development, and characteristics of system for speech understanding
[AD-735758] c07 N72-21187

**PHONONS**
Tunneling measurements of superconduction quasiparticle density of states of metals and semiconductors, and calculation of phonon spectra
c26 N72-21781

**PHOSPHORESCENCE**
Fluorescence, phosphorescence, and triplet quantum yields for organic molecules in rigid plastic media as function of temperature
[AD-735483] c06 N72-21113

**PHOTOABSORPTION**
Analysis of photoabsorption and thermal processes occurring in polar thermosphere through deposition or loss of thermal energy or modification of composition
[AD-735305] c13 N72-21400
Measurement of absorption structure of lithium, beryllium, sodium, magnesium, and aluminum by photoabsorption process
c26 N72-21735

**PHOTOCHROMISM**
Environmental tests on high contrast laser-photochromic projection device, based on random access positioning
[AD-735281] c09 N72-21263
Radiation effects on properties of photochromic materials incorporated in plastics and used in holography and other optical data processing methods
[LCR-DR-70-90/1/R] c23 N72-21664

**PHOTOCONDUCTIVITY**
Photofabrication techniques for selective removal of conductive metals oxide coatings from nonconductive substrates
[NASA-CASE-ERC-10108] c06 N72-21094

**PHOTODIODES**
Applications of semiconductor diode lasers including use in construction of fast operating logic circuit elements
[AD-735463] c16 N72-21506

**PHOTOELECTRIC EFFECT**
Theory of external photoelectric effect in terms of quadratic response to incident electromagnetic field
c26 N72-21719

**PHOTOELECTRIC EMISSION**
Ultraviolet photoemission methods of determining density of valence and conduction states
[NASA-CR-126040] c26 N72-21720

Interpreting photoemission data from indium and aluminum in terms of density of states models
c26 N72-21721
Electron density of states for noble and transition metals by X ray photoelectron spectroscopy
c26 N72-21722
Energy distribution of optically excited electrons in Pd arising from direct interband transitions assuming constant momentum matrix elements
c26 N72-21723
Photoemission determination of energy distribution of joint density of states in copper
c26 N72-21724
Band structure of tungsten in energy region of 5d bands by photoelectric spectroscopy
c26 N72-21725
Structure of d-band for Sc, Ti and Zr in 4 to 11.6 eV range by photoemission spectroscopy
c26 N72-21726
Photoemission and optical measurement studies of electronic structure of vapor deposited molybdenum films
[NASA-CR-126041] c26 N72-21727
Measurement of photoemission from thin films of europium and barium excited by vacuum ultraviolet and soft X ray radiation
c26 N72-21728
Photoelectric emission technique used to study density of states of three silver based alloys
c26 N72-21770

**PHOTOGRAMMETRY**
Development of automatic process for compiling thematic and general geographic maps
[AD-736481] c13 N72-21402

**PHOTOGRAPHIC EMULSIONS**
Physical processes involved in transformation of gamma ray energy into optical information on photographic emulsions
[NP-19129] c24 N72-21682

**PHOTOGRAPHIC FILM**
Mechanical exposure interlock device for preventing film overexposure in oscilloscope camera
[NASA-CASE-LAR-10319-1] c14 N72-21423
Radiographic indications film interpreter might encounter during evaluation of aluminum alloy welds
[NASA-CR-123488] c15 N72-21467

**PHOTOGRAPHIC RECORDING**
Application of space photography for monitoring surface mining operations
c13 N72-21362
Low light image recording system for recording data from optical telescopes
[AD-735830] c23 N72-21669

**PHOTOINTERPRETATION**
Application of space photography for monitoring surface mining operations
c13 N72-21362
Application of aerial photographic interpretation in field and office geomorphological research
[NASA-TT-F-624] c13 N72-21364
Radiographic indications film interpreter might encounter during evaluation of aluminum alloy welds
[NASA-CR-123488] c15 N72-21467
Analysis of microdensitometer measurements of Apollo 12 photographs of clouds caused by venting liquids into space
[NASA-CR-125934] c31 N72-21885

**PHOTOLUMINESCENT BANDS**
Application of electroreflectance techniques to determine band population effects in indium antimonide
c26 N72-21752

**PHOTOMETERS**
Development of high performance infrared photodetectors
[NASA-CASE-LAR-10728-1] c14 N72-21422

**PHOTOMULTIPLIER TUBES**
Photomultiplier tube for infrared detection
[AD-735323] c23 N72-21672

**PHOTONS**
Application of positron annihilation for measuring density of states in alpha and beta brass
c26 N72-21745

**PHYSICAL PROPERTIES**
Numerical analysis of density conditions necessary for production of phase transition in solids
c26 N72-21750
Mathematical model of physical properties of density of states of noninteracting electrons moving in static potential of disordered systems
c26 N72-21759
Development of procedures for determining strength of cast turbine blades under variable load conditions
[JPRS-55555] c28 N72-21818

**PHYSICS**
Information system for physics
[PB-204859] c34 N72-21990

**PIERCING**
Inflatability and flotation of one man life raft after puncture to main wall
[NASA-CASE-LAR-10241-1] c05 N72-21076

**PIEZOELECTRIC CRYSTALS**
Measurement of effects produced by modulation of emission band of polycrystalline copper by alternating elastic strain
c26 N72-21736
Equations of motion for high frequency vibrations of piezoelectric crystal plates
[AD-735956] c26 N72-21803

**PIEZOELECTRIC TRANSDUCERS**
Piezojunction electromechanical stress transducer
[NASA-CASE-ERC-10087-2] c14 N72-21430

**PILOT ERROR**
Relative incidence and cost data for orientation-error accidents in regular Army UH-1 aircraft during fiscal year 1968
[AD-735457] c02 N72-21016

**PILOT TRAINING**
Organization and operation of US Air Force Test Pilot School
c11 N72-20994
Procedures for training pilots in assessment of flight systems during attendance at Empire Test Pilot School, England
c11 N72-20995
Organization, operation, and curriculum of U.S. Navy Test Pilot School at Patuxent Naval Air Station, Maryland
c11 N72-20996
Application of systems engineering concept to US Coast Guard aviator training programs
[AD-735051] c05 N72-21080

**PILOTS [PERSONNEL]**
Analysis of information flow requirements between control tower operators and aircraft pilots and methods for displaying information
[DOT-TSC-FAA-71-18] c02 N72-21000

**PIONS**
Pion exchange processes for elementary pion with transverse momentum cut-off
[NOTA-INTERNA-342] c24 N72-21687
Angular behavior of K/Pi ratio at high energy in multi-Regge model
[NOTA-INTERNA-338] c24 N72-21688

**PIPES [TUBES]**
Pressure loss and heat transfer for electrically heated rough rods in concentric smooth tubes
[NP-19112] c22 N72-21649

**PISTONS**
Pumping and metering dual piston system and monitor for reaction chamber constituents
[NASA-CASE-GSC-10218-1] c15 N72-21465

**PITOT TUBES**
Experimental pitot probe displacement measurements in supersonic turbulent boundary layer
[NASA-TN-D-6759] c12 N72-21313

**PLANE WAVES**
Calculating band structure of ferromagnetic iron by variational method using tight binding functions and orthogonalized plane waves
c23 N72-21708
Effects of compression on band structure and density of states of alkaline metals by augmented plane wave method
c26 N72-21712
Calculating electron density of states using self-consistent orthogonalized plane wave model for compounds in isoelectronic sequences Si-AlP and Ge-GaAs-ZnSe
c26 N72-21714
Spin-polarized energy bands and electronic density of states in Eu-chalcogenides by augmented plane wave
c26 N72-21715

**PLANET EPHEMERIDES**
Magnetic tapes with ephemeris data for moon and nine planets
[NASA-CR-123595] c30 N72-21857

**PLANETARY QUARANTINE**
Requirements for effective planetary quarantine and spacecraft sterilization
[NASA-CR-126033] c04 N72-21049
Mathematical models for predicting safety margins in planetary quarantine
[NASA-CR-126032] c04 N72-21050

**PLANETARY SURFACES**
Spacecraft transponder and ground station radar system for mapping planetary surfaces
[NASA-CASE-NPO-11001] c07 N72-21118

**PLANETS**
Planetary resonance structure, sunspot activity, and bistable modes of solar oscillation
[NASA-CR-2035] c30 N72-21870

**PLANTS [BOTANY]**
Utilization of natural plant growth to model HF-VHF radio transmission in jungle forest type terrain
[AD-735335] c07 N72-21180

**PLASMA CONTROL**
Alternating direction implicit finite difference method for studying theta pinch dynamics and plasma control
[UCRL-51103] c25 N72-21695

**PLASMA DENSITY**
Dayside auroral, oval plasma density and conductivity enhancement due to magnetosheath electron precipitation
[NASA-CR-125929] c13 N72-21354

**PLASMA DIAGNOSTICS**
Plasma diagnostic methods for measuring laser dispersion and interferometric phenomena
[AD-735480] c25 N72-21696

**PLASMA ENGINES**
Pulsed inductive plasma thruster
[AD-735721] c28 N72-21824

**PLASMA HEATING**
Analysis of high temperature plasma heating phenomena produced by ultrashort laser pulses
[AD-736483] c25 N72-21698

**PLASMA JETS**
Nitride production utilizing plasma jets
[NLL-RTS-6884] c06 N72-21092

**PLASMA OSCILLATIONS**
Development of theory for formation of stable auroral red arcs at plasmapause
[AD-736431] c13 N72-21403

**PLASMA PHYSICS**
Reaction rate series, including research on reaction kinetics, diatomic molecules, and plasma physics
[AD-735510] c06 N72-21115
Development of optical striations and Doppler spectrum broadening due to barium plasmas in ionosphere
c07 N72-21136
Development and characteristics of shock tube for analyzing argon plasma optical properties
[FRNC-TH-70] c11 N72-21302
Scientific research in theoretical plasma, and solid state physics and communication and microwave transmission
[AD-735366] c23 N72-21673
Theoretical plasma physics and ionospheric plasmas
[NASA-CR-125979] c25 N72-21690

**PLASMA WAVES**
Ionograms and morphological statistics of polar slant E condition, emphasizing two stream or plasma ion wave instability
c07 N72-21148

**PLASMAPAUSE**
Pitch-angle diffusion of radiation belt electrons within plasmasphere
[AD-735934] c13 N72-21382
Development of theory for formation of stable auroral red arcs at plasmapause
[AD-736431] c13 N72-21403

**PLASMAS [PHYSICS]**
Spatial distribution of plasma in polar exosphere based on satellite data
c29 N72-21124
Ion-acoustic waves in auroral plasma and radio wave scattering
c13 N72-21132
Differential calculus methods for determining conductivity of ionized gas and shock wave ionized plasmas
[FRNC-TH-75] c25 N72-21694
Radar reflection coefficients from one dimensional plasma and effects of electron-neutral and electron-ion collisions
[AD-735146] c25 N72-21697

**PLASMONS**
Plasmon induced structure in optical interband absorption of free electrons
c26 N72-21718

**PLASTIC COATINGS**
Suitability and reliability considerations in plastic encapsulated microcircuit applications
[AD-735500] c09 N72-21261
Wear resistance and durability of coatings from dry polyvinyl butyral paint SVL-21
[AD-735238] c18 N72-21562

**PLASTIC PROPERTIES**
Superplastic alloys and metals
[NLL-RTS-6944] c17 N72-21515

**PLASTICS**
Fluorescence, phosphorescence, and triplet quantum yields for organic molecules in rigid plastic media as function of temperature
[AD-735483] c06 N72-21113
Plastic sphere for radar tracking and calibration
[NASA-CASE-XLA-11154] c07 N72-21117
Apparatus and method for compression molding of thermosetting plastics
[NASA-CASE-LAR-10489-1] c15 N72-21484

**PLATES [STRUCTURAL MEMBERS]**
Mechanical properties and stress corrosion of hot rolled alloy plates
c32 N72-21931
Computer program based on finite element method for analysis of stiffened plates under combined in-plane and lateral loads
[AD-735936] c32 N72-21936
Nonlinear analysis of plates considering geometric and material effects, including large deflections
[AD-735937] c32 N72-21938
Thermoelastic stress conditions and heat conductivity of plates and bodies of revolution
[AD-735582] c33 N72-21961

**PLETHYSMOGRAPHY**
Whole body plethysmograph system for use in measuring airway resistance under ambient hyperbaric conditions for normal breathing patterns
[AD-735462] c05 N72-21081
**PLOTTERS**
Plotter device for automatically drawing equipotential lines on sheet of resistance paper
[NASA-CASE-NPO-11134] c09 N72-21246
**PLUTONIUM ISOTOPES**
Avalanche detector array for measuring low level plutonium in esophagus
[NYO-3246-TA-9] c14 N72-21440
**PLUTONIUM 238**
Vapor cycle engine for driving Pu 238 fueled heart assist system
[PB-205474] c05 N72-21086
**PNEUMATIC EQUIPMENT**
Multichannel pneumoacoustic control system for open drive
[AD-735234] c15 N72-21495
Elastomers for gaskets in pneumatic and hydraulic systems
[NASA-TN-D-6693] c18 N72-21556
**POINTING CONTROL SYSTEMS**
Pointing capability of isolation and control system of Apollo type telescope mount
[NASA-TN-D-6676] c30 N72-21863
**POLAR CAPS**
Access of solar protons and electrons to magnetotail and north polar cap
c29 N72-21837
**POLAR REGIONS**
Particle precipitation in polar upper atmosphere
c07 N72-21122
Spatial distribution of plasma in polar exosphere based on satellite data
c29 N72-21124
Polar propagation effects on HF radar in auroral and subauroral regions
c07 N72-21142
Analysis of photoabsorption and thermal processes occurring in polar thermosphere through deposition or loss of thermal energy or modification of composition
[AD-735305] c13 N72-21400
Solar electron and proton measurements in interplanetary space and magnetotail during onset of solar particle event, and comparison with continuous transpolar VLF data
[AD-736430] c29 N72-21855
**POLARIMETERS**
Polarization characteristics of Intelsat 2F-1 signals
[KGO-721] c23 N72-21665
**POLARIZATION [SPIN ALIGNMENT]**
Spin-polarized energy bands and electronic density of states in Eu-chalcogenides by augmented plane wave
c26 N72-21715
**POLARIZATION [WAVES]**
Radio wave polarization in auroras
c07 N72-21133
**POLARIZATION CHARACTERISTICS**
Polarization coupling losses on sky wave paths at high altitude
c07 N72-21145
Polarization characteristics of Intelsat 2F-1 signals
[KGO-721] c23 N72-21665
**POLYIMIDES**
Polyimide foams produced in presence of alkanolamine or siloxane-glycol polymer
[NASA-CASE-ARC-10464-1] c06 N72-21102
Heat treatment of hydrolytically degraded polyimide film and regeneration of tensile properties
[RM-538] c06 N72-21104
**POLYMERS**
Studying kinetics of degradation of polystyrenes and copolymers by dynamic thermogravimetry in vacuum
[AD-735278] c18 N72-21561
**POLYNOMIALS**
Polynomials orthogonal to holomorphic functions of many complex variables and analog of Riesz-Fischer theorem
[NLL-M-22038-[5828.4F]] c19 N72-21566
**POLYQUINOXALINES**
Fabrication of carbon fiber composites using high temperature phenylated polyquinoxaline
[AD-735876] c18 N72-21563
**POROSITY**
Polycrystalline oxide ceramic development, densification and porosity change kinetics, and Nd doped yttrium oxide rods as laser material
[AD-736223] c16 N72-21513
**POROUS MATERIALS**
Prediction theories for shock wave attenuation in porous materials
[AD-735761] c12 N72-21326
Processing and parameters for fabrication of controlled permeability porous beryllium billets from powder
[AD-736484] c17 N72-21554
**PORTABLE EQUIPMENT**
Portable equipment for detecting myocardial activity
[AD-735882] c05 N72-21084
Portable vacuum surface probe for sampling spacecraft surface for microorganisms
[NASA-CASE-LAR-10623-1] c14 N72-21415
**POSITIONING DEVICES [MACHINERY]**
Positioning mechanism for converting translatory motion into rotary motion
[NASA-CASE-NPO-10679] c15 N72-21462
**POSITRON ANNIHILATION**
Muon pair production by electron-positron annihilation at energies up to 2.1 GeV
[NOTA-INTERNA-336] c24 N72-21689
Application of positron annihilation for measuring density of states in alpha and beta brass
c26 N72-21745
**POSITRONS**
Positron and electron interactions in omega and phi meson regions at 990 MeV
[LAL-1256] c24 N72-21680
**POTASSIUM CHLORIDES**
Thermodynamics of capillary porous body/liquid system involving graphite, water, and chlorides
c18 N72-21519
**POTASSIUM COMPOUNDS**
Magnetic hyperfine structure and Mossbauer effect in rubidium and potassium fluorides
[BNL-16326] c06 N72-21107
Preparation and crystal structure of KAgO and CsAgO
[NASA-TT-F-14192] c26 N72-21799
**POTENTIAL THEORY**
Generalized coherent potential theory of electronic structure of disordered systems
[NASA-CR-126044] c26 N72-21764
**POTTING COMPOUNDS**
Thermally conductive polymer for potting electrical components
[NASA-CASE-GSC-11304-1] c06 N72-21105
**POWDER METALLURGY**
Superalloy material from prealloyed powders
[NASA-CASE-LEW-10805-2] c15 N72-21485
**POWER AMPLIFIERS**
Two broadband amplifier chains
[AD-735755] c09 N72-21268
**POWER SERIES**
Power series solutions for supersonic flow in ideal dissociating gas
[AD-735697] c12 N72-21323
**PREAMPLIFIERS**
Very high resolution X ray spectrometry with cooled Si[Li] detectors and optoelectron preamplifier
[CEA-CONF-1840] c14 N72-21439
**PRECIPITATION [METEOROLOGY]**
Discriminant analysis procedure for predicting quanity of monthly precipitation
[AD-735468] c20 N72-21593
Thermal parameters for predicting precipitation type for Loring AFB, Maine
[AD-735724] c20 N72-21616
**PREDICTIONS**
Prediction theories for shock wave attenuation in porous materials
[AD-735761] c12 N72-21326
Ground motion predictions for Rio Blanco explosion
[NVO-1163-228] c13 N72-21369
**PREFLIGHT OPERATIONS**
Computerized simulation of Skylab 1B vehicle response to winds during propellant loading at launch pad for determining displacements and bending moments
[NASA-CR-123564] c31 N72-21878
**PRESSURE BREATHING**
Development and tests of sensitive methodologies for measuring sensory and motor impairment in hyperbaric environments
[AD-735117] c04 N72-21062
**PRESSURE DISTRIBUTION**
Effects of exposure to blast induced winds and pressure variations on biophysical parameters
[AD-734208] c04 N72-21054
**PRESSURE EFFECTS**
Nonrelativistic KKR calculations of Fermi surface properties of Cu, Ag, and Au at normal volume as function of pressure
c26 N72-21711
Interpretation of absolute Knight shifts of alkalis, variations with pressure, and absolute Knight shifts in binary alkali systems
c26 N72-21778
Hydrostatic pressure effects on Hall effect and magnetoresistance in graphite crystals with current flow in basal planes
c18 N72-21785
Effect of pore pressures on soil-wheel interaction
[AD-735792] c32 N72-21942
**PRESSURE MEASUREMENTS**
Development and characteristics of balloon interrogation package for use with Nimbus 4 satellite
[NASA-CR-122375] c14 N72-21410
Measurement of dynamic response characteristics of high frequency pressure transducers using large amplitude, sinusoidal pressure geaerator
[NASA-CR-2000] c14 N72-21412
**PRESSURE OSCILLATIONS**
Dynamic performance characteristics of large amplitude sinusoidal pressure generator used to calibrate pressure transducers
[NASA-CR-120874] c14 N72-21428
**PRESSURE SENSORS**
Pressure transducer for systems for measuring forces of compression
[NASA-CASE-NPO-10832] c14 N72-21405
Measurement of dynamic response characteristics of high frequency pressure transducers using large amplitude, sinusoidal pressure generator
[NASA-CR-2000] c14 N72-21412
Dynamic performance characteristics of large amplitude sinusoidal pressure generator used to calibrate pressure transducers
[NASA-CR-120874] c14 N72-21428
Piezojunction electromechanical stress transducer
[NASA-CASE-ERC-10087-2] c14 N72-21430
**PRESSURE SUITS**
Evaluation of oxygen-sensing warning device for use in damage control suit system
[AD-735377] c05 N72-21082
**PRESSURE VESSELS**
Insulation tests for prestressed concrete reactor vessels of water reactors
[CONF-710903-6] c22 N72-21652
Computer programs for calculating elastic stress intensity factors of pressure hulls
[AD-735874] c32 N72-21943
**PRESSURIZING**
Deployable pressurized cell structures for micrometeoroid penetration detector
[NASA-CASE-LAR-10295-1] c15 N72-21472
**PRESTRESSING**
Insulation tests for prestressed concrete reactor vessels of water reactors
[CONF-710903-6] c22 N72-21652
**PRIMATES**
Indirect measurement of primate vestibular system function through analysis of vestibulo-ocular reflex response to various input stimuli
[AD-734545L] c04 N72-21065
Sham-exposed controls and body weight variation in primates exposed to 55 MeV protons
[AD-734779] c04 N72-21066
**PRINTING**
Effect of double corona charging units on chemistry of materials used in electrostatic printing process
[AD-735369] c15 N72-21491
**PRISMS**
Interferometric prism and control system for precisely determining direction to remote light source
[NASA-CASE-ARC-10278-1] c14 N72-21434
**PROBES**
Evaluation of static-pressure measuring probes used in wind tunnel tests at supersonic and hypersonic speeds
[AD-736017] c14 N72-21461
**PRODUCT DEVELOPMENT**
Advantages of using tungsten carbides in commercial cemented carbides
[NLL-TRANS-746-1099-[9022.401]]
c06 N72-21091
Design, development, and characteristics of system for speech understanding
[AD-735758] c07 N72-21187
Simplified technique and device for producing industrial grade synthetic diamonds
[NASA-CASE-MFS-20698-2] c15 N72-21481
Thermal stability of molybdenum alloy, low alloy steel production and economics, and improving sound metal yield in cast and rolled products
[NLL-M-21286-[5828.4F]] c17 N72-21514
**PRODUCTION ENGINEERING**
Application of distribution functions and stochastic processes to determine production capability of series of work stations with variable service times
[AD-735363] c15 N72-21498
**PROGRAMMED INSTRUCTION**
Automated instructional monitors for diagnosing student difficulties in acquiring complex concepts and skills
[AD-736212] c05 N72-21090
**PROGRAMMING LANGUAGES**
Flight programming languages for aerospace applications
[NASA-CR-123569] c08 N72-21201
Comparative evaluation of eight higher order languages of general interest in aerospace fields
[NASA-CR-115515] c08 N72-21203
Problem of representing groups of loosely connected processes and model for process representation useful for synthesizing complex patterns of process behavior
[NASA-CR-122379] c08 N72-21207
**PROJECT MANAGEMENT**
Design, development, and project management of modular space station concept to include cost analyses and equipment specifications
[NASA-CR-123541] c31 N72-21884
**PROJECT PLANNING**
Project and mission planning for European space programs
c11 N72-21293

**PROJECTILES**
Coaxial plasma accelerator as projectile accelerator
[NASA-TN-D-6687] c25 N72-21691
**PROJECTORS**
Environmental tests on high contrast laser-photochromic projection device, based on random access positioning
[AD-735281] c09 N72-21263
**PROPELLANT COMBUSTION**
Combustion characteristics of NH4ClO4 composite propellants and effect of solid phase reactions on ballistic properties of composite propellants
[NASA-CR-111940] c27 N72-21809
**PROPELLANT PROPERTIES**
Combustion characteristics of NH4ClO4 composite propellants and effect of solid phase reactions on ballistic properties of composite propellants
[NASA-CR-111940] c27 N72-21809
**PROPELLANT STORAGE**
Long term storability of liquid rocket propellant tankage
[AD-735288] c27 N72-21811
**PROPORTIONAL COUNTERS**
Position sensitive proportional counter for neutron imaging applications
[BNWL-SA-3936] c14 N72-21441
**PROPULSION SYSTEM CONFIGURATIONS**
Development of procedure for calculating various interactions of ion thrusters with spacecraft surface
[NASA-TM-X-68043] c28 N72-21815
Design problems of inlets and nozzles used in supersonic and V/STOL propulsion systems
[NASA-TM-X-67741] c28 N72-21819
**PROPULSION SYSTEM PERFORMANCE**
Characteristics of aircraft using supercritical aerodynamics and analysis of turbofan engine performance with single and double stage configurations
[NASA-TM-X-68031] c28 N72-21816
Analog and digital computer simulation analysis of performance and control of low-pressure-ratio turbojet engine for drone aircraft
[NASA-TM-X-2537] c28 N72-21817
**PROTECTIVE COATINGS**
Measurement of solar absorption and thermal emittance properties of selected thermal control coatings exposed to exhaust of thruster engine
[NASA-TM-X-68044] c33 N72-21952
**PROTEINS**
Series analyses method for determining protein content of intact microorganisms
[NASA-TT-F-14253] c04 N72-21042
**PROTON BEAMS**
Determining suitability of supersonic jets for proton beam neutralizer
[UCRL-51089] c12 N72-21318
**PROTON IRRADIATION**
Sham-exposed controls and body weight variation in primates exposed to 55 MeV protons
[AD-734779] c04 N72-21066
**PROTONS**
Specifications for magnetic proton spectrometer facility
[LA-4773-PT-1] c14 N72-21436
**PROTOTYPES**
Life tests for SNAP 23A fueled prototype mockup system
[WANL-4219-1] c22 N72-21656
Prototype alkali vapor flash lamps
[AD-735951] c23 N72-21666
**PULSE GENERATORS**
Application of explosive driven magnetohydrodynamics for producing pulses at multimegajoule levels
[AD-735660] c15 N72-21497
**PULSE RATE**
Response of ventilation parameters, pulse rate, oxygen uptake, and body temperature in man under acute and severe hypoxia
[DLR-FB-71-65] c04 N72-21053
**PULSE WIDTH AMPLITUDE CONVERTERS**
DC/DC converter for space application using linear analog to pulse width conversion in control loop to gain amplified regulated voltage
[ESRO-TN-105-ESTEC] c09 N72-21258
**PUMPS**
Pumping and metering dual piston system and monitor for reaction chamber constituents
[NASA-CASE-GSC-10218-1] c15 N72-21465
**PYROELECTRICITY**
Improved detectivity of pyroelectric detectors through use of new materials and improved field effect transistors
[NASA-CR-122382] c14 N72-21427
**PYROTECHNICS**
Application of self-balancing bridge for determining electrothermal and nonlinear behavior of electroexplosive device
[NASA-CR-125931] c11 N72-21281
**PYRUVATES**
Glycolytic metabolism effects from responses of blood lactate-pyruvate and redox state to chronic exposure to 3 percent CO2
[AD-734122] c04 N72-21059

## Q

**QUALITY CONTROL**
Flight tests performed following initial delivery or extensive repair and overhaul as performed by Canadian Armed Forces
c02 N72-20987
Development of high performance infrared photodetectors
[NASA-CASE-LAR-10728-1] c14 N72-21422
**QUANTUM ELECTRODYNAMICS**
Electron-positron storage rings noting QED, vector meson, and hadronic experiments
[NOTA-INTERNA-343] c24 N72-21686
**QUANTUM MECHANICS**
Measuring noncommuting operators in quantum detection and estimation theory
[NASA-CR-122364] c24 N72-21675
**QUARTZ CRYSTALS**
Processing methods for model quartz crystal units with equivalent circuit parameters and high shock resistance
[AD-735685] c26 N72-21808
**QUEUEING THEORY**
Military requirements, criteria, and force structure for Coast Guard search and rescue operations
[AD-735408] c34 N72-21989

## R

**RADAR**
Characteristics and effects of Arctic ionosphere on radio and radar propagation - conference
[AGARD-CP-97] c07 N72-21121
Auroral radar network for statistical and single event studies of radio aurora morphology and scattering mechanisms
c13 N72-21127
Radar aurora studies using backscatter radar
c07 N72-21129
Radar aurora at frequency of 1295 MHz
c07 N72-21130
Ionospheric propagation model and application to high latitude HF radar propagation
c07 N72-21153
Anticipatory sensing of impending automobile accidents using microwave radar and ultrasonic sonar
[PB-204806] c14 N72-21449
**RADAR ANTENNAS**
Effect of external noise on angular resolution of highly directional radar antenna and radar range of ground station following heat shock of radome
[JPRS-55618] c07 N72-21156
Effects of external noise on angular resolution of highly directional radar antenna
c07 N72-21157
**RADAR BEACONS**
HF auroral backscatter, scintillation theory, and satellite beacon recordings
c07 N72-21150
**RADAR ECHOES**
Electron density distribution and electron temperature measurements of F region by Millstone Hill Thomson scatter radar system during 1967
[AD-735727] c13 N72-21387
Comparison of simultaneous raindrop and radar pulse integrator observations for rain intensity associated with cold front passage
[NLL-M-22067-[5828.4F]] c20 N72-21588
Radar reflection coefficients from one dimensional plasma and effects of electron-neutral and electron-ion collisions
[AD-735146] c25 N72-21697
**RADAR EQUIPMENT**
Spacecraft transponder and ground station radar system for mapping planetary surfaces
[NASA-CASE-NPO-11001] c07 N72-21118
Designing filters for detection and estimation in radar and communications systems with inequality constraints on maximum output sidelobes
[NASA-CR-125935] c07 N72-21120
Sweep frequency backscatter radars as detectors of high latitude ionospheric phenomena
c07 N72-21147
Effect of external noise on angular resolution of highly directional radar antenna and radar range of ground station following heat shock of radome
[JPRS-55618] c07 N72-21156
Antiaircraft defense, including reliability and efficiency of radar data, tactics exercise, and recording equipment parameters
[AD-735425] c34 N72-21980
**RADAR IMAGERY**
Design, development, and characteristics of remote sensing systems and display devices for aerial reconnaissance and radar imagery
[AD-735752] c07 N72-21188
**RADAR RANGE**
Determination of effects of shock heating of radome on radar range of ground station
c07 N72-21158
**RADAR SCANNING**
Ray tracing method used to evaluate scanning capabilities of offset-feed near-field Gregorian antenna excited with planar array
[AD-736029] c07 N72-21193
**RADAR SIGNATURES**
Measurement of peak electron density in barium clouds as function of time using multifrequency, high frequency radar observations
[AD-736040] c12 N72-21328
**RADAR TRACKING**
Plastic sphere for radar tracking and calibration
[NASA-CASE-XLA-11154] c07 N72-21117
**RADAR TRANSMISSION**
Polar propagation effects on HF radar in auroral and subauroral regions
c07 N72-21142
Effect of external noise on angular resolution of highly directional radar antenna and radar range of ground station following heat shock of radome
[JPRS-55618] c07 N72-21156
**RADIANCE**
Infrared radiance from geological materials and system for airborne use over terrain with little vegetation
[NASA-CR-115524] c13 N72-21356
**RADIATION BELTS**
Pitch-angle diffusion of radiation belt electrons within plasmasphere
[AD-735934] c13 N72-21382
**RADIATION DAMAGE**
Notch sensitivity of various steels and alloys used in reactor materials after irradiation
[AD-735872] c22 N72-21659
Fabrication and experimental analysis of metal insulator semiconductor devices for radiation vulnerability studies
[AD-735947] c26 N72-21804
Solar proton radiation damage of solar cells at synchronous altitudes
c03 N72-21847
**RADIATION DETECTORS**
Avalanche detector array for measuring low level plutonium in esophagus
[NYO-3246-TA-9] c14 N72-21440
**RADIATION EFFECTS**
Pre- and post-irradiation electrical and optical properties of Ga As laser diodes
[AD-735939] c16 N72-21507
**RADIATION MEASUREMENT**
Radiation measurements for determination of atmospheric dust particle concentration
[ISL-6/71] c13 N72-21373
**RADIATION MEASURING INSTRUMENTS**
Radiation measuring instruments designed for civil defense use
[ORNL-TM-3370] c14 N72-21438
**RADIATION PROTECTION**
Ocular laser protective filter with narrowband absorption, luminous transmission, and optical density of 3.5
[AD-735799] c05 N72-21083
**RADIATION SHIELDING**
Reactor shielding for fast test and liquid metal fast breeder reactors
[ORNL-TM-3639] c22 N72-21654
Apparatus for aligning shadow shields and cryogenic storage tanks in outer space with the sun
[NASA-CASE-KSC-10622-1] c31 N72-21893
**RADIATIVE HEAT TRANSFER**
Role of solids thermal microwave noise in earth resources microwave radiometry
[RAC-0-3-R16] c07 N72-21163
**RADIO ANTENNAS**
Design, development, and evaluation of low silhouette, portable, high frequency antenna for ground to ground communication
[AD-735679] c07 N72-21172
**RADIO COMMUNICATION**
Designing filters for detection and estimation in radar and communications systems with inequality constraints on maximum output sidelobes
[NASA-CR-125935] c07 N72-21120
Characteristics of ultrahigh frequency and very high frequency aircraft antennas for aircraft-satellite communications link
[PB-204799] c07 N72-21165
Recommendations for changes in Federal Communication rules governing Citizens Radio Service
[PB-204595] c07 N72-21190
Application of communication satellites to provide worldwide maritime communication system
[PB-204860] c07 N72-21191
**RADIO EQUIPMENT**
Characteristics of ultrahigh frequency and very high frequency aircraft antennas for aircraft-satellite communications link
[PB-204799] c07 N72-21165
**RADIO FILTERS**
Designing filters for detection and estimation in radar and communications systems with inequality constraints on maximum output sidelobes
[NASA-CR-125935] c07 N72-21120

**RADIO FREQUENCY INTERFERENCE**
Tables on structure and magnitude of loran-C propagation anomaly caused by 100 kHz pulse on isolated terrain
[AD-735680] c21 N72-21638
**RADIO FREQUENCY SHIELDING**
Gunn effect microwave diodes with RF shielding
[NASA-CASE-ERC-10119] c26 N72-21701
**RADIO NAVIGATION**
Geomagnetism, satellite tracking, oceanography, hyperbolic navigation, and radio equipment research projects
[AD-735169] c21 N72-21639
**RADIO RECEIVERS**
Determination of short pulse, radio frequency burnout properties of crystal diode mixers by application of pulses of controlled amplitude
[AD-735341] c09 N72-21266
**RADIO RELAY SYSTEMS**
Differential detection to demodulate data carrying pulses in radio relay systems
[AD-734255] c07 N72-21167
Design and characteristics of satellite communication system for naval communications
[AD-736115] c07 N72-21192
**RADIO SIGNALS**
High latitude studies of scintillation in radio signals from radio sources and satellites
c07 N72-21137
**RADIO SOURCES (ASTRONOMY)**
High latitude studies of scintillation in radio signals from radio sources and satellites
c07 N72-21137
High resolution interferometric observations of galactic center
[AD-734376] c29 N72-21854
**RADIO TRANSMISSION**
Design, development, and evaluation of low silhouette, portable, high frequency antenna for ground to ground communication
[AD-735679] c07 N72-21172
Utilization of natural plant growth to model HF-VHF radio transmission in jungle forest type terrain
[AD-735335] c07 N72-21180
Characteristics of satellite-to-ground whistler mode communication link
[AD-736429] c07 N72-21194
Tables on structure and magnitude of loran-C propagation anomaly caused by 100 kHz pulse on isolated terrain
[AD-735680] c21 N72-21638
**RADIO WAVES**
Bibliography of reported biological responses and clinical manifestations attributed to microwave and radio frequency radiation
[AD-734391] c04 N72-21071
Characteristics and effects of Arctic ionosphere on radio and radar propagation - conference
[AGARD-CP-97] c07 N72-21121
Auroral radar network for statistical and single event studies of radio aurora morphology and scattering mechanisms
c13 N72-21127
Radio wave scattering from auroral ionization
[NASA-TM-X-68302] c07 N72-21131
Ion-acoustic waves in auroral plasma and radio wave scattering
c13 N72-21132
Radio wave polarization in auroras
c07 N72-21133
Angular deviations of radio waves from horizontal stratification
c07 N72-21139
Partial reflections of radio waves from lower ionosphere
[NASA-TN-D-6742] c13 N72-21361
Gunn effect microwave diodes with RF shielding
[NASA-CASE-ERC-10119] c26 N72-21701
Origin of Tunguska meteorite, meteoritic fallout, and radio wave studies of meteors
[NLL-M-22218-[5828.4F]] c30 N72-21856
**RADIOACTIVE WASTES**
Computer program for economic analysis of managing high level radioactive wastes from reprocessing power reactor fuels
[ORNL-4633] c22 N72-21648
Measurement and control of radioactive wastes in environment, soil, and water
[CONF-711113-3] c22 N72-21653
Effects of radioactive wastes from nuclear power generation on environment
[CONF-711113-2] c22 N72-21658
**RADIOACTIVITY**
Manmade and natural radioactivity in atmosphere
[AEC-TR-7268] c13 N72-21370
**RADIOBIOLOGY**
Bibliography of reported biological responses and clinical manifestations attributed to microwave and radio frequency radiation
[AD-734391] c04 N72-21071
**RADIOGRAPHY**
Position sensitive proportional counter for neutron imaging applications
[BNWL-SA-3936] c14 N72-21441
Radiographic indications film interpreter might encounter during evaluation of aluminum alloy welds
[NASA-CR-123488] c15 N72-21467
**RADIOMETERS**
Temperature measurement system of radiometer type
[NASA-CASE-MFS-20781] c14 N72-21429
**RADOMES**
Determination of effects of shock heating of radome on radar range of ground station
c07 N72-21158
**RAIN**
Calendar days with 30 mm or more rain in 24 hour period - northwest U.S.S.R.
[NLL-M-22061-[5828.4F]] c20 N72-21586
Comparison of simultaneous raindrop and radar pulse integrator observations for rain intensity associated with cold front passage
[NLL-M-22067-[5828.4F]] c20 N72-21588
**RAINDROPS**
Comparison of simultaneous raindrop and radar pulse integrator observations for rain intensity associated with cold front passage
[NLL-M-22067-[5828.4F]] c20 N72-21588
**RANDOM NUMBERS**
Pseudo-random number generating programs in Assembly language for random values from discrete probability distributions
[AD-735144] c19 N72-21577
**RANGEFINDING**
Orbital and entry tracking accessory mounted on global map to provide range requirements for reentry vehicles to any landing site
[NASA-CASE-LAR-10626-1] c14 N72-21416
**RANKINE CYCLE**
Design and fabrication of three-phase helical induction electromagnetic pump for use as boiler-feed pump of potassium Rankine cycle space electric power system
[NASA-CR-1949] c15 N72-21479
Design for steam Rankine cycle system for undersea applications
[ORNL-TM-2961] c22 N72-21655
**RARE GASES**
Mechanism by which inert gases influence metabolism
[NASA-CR-62079] c04 N72-21041
**RATS**
Effects of high altitude on cellular and energy metabolism in rats
[AD-734933] c04 N72-21064
**RAY TRACING**
Ray tracing method used to evaluate scanning capabilities of offset-feed near-field Gregorian antenna excited with planar array
[AD-736029] c07 N72-21193
**RC CIRCUITS**
Multiloop RC active filter network with low parameter sensitivity and low amplifier gain
[NASA-CASE-ARC-10192] c09 N72-21245
**REACTION TIME**
Reaction rate series, including research on reaction kinetics, diatomic molecules, and plasma physics
[AD-735510] c06 N72-21115
**REACTOR MATERIALS**
Notch sensitivity of various steels and alloys used in reactor materials after irradiation
[AD-735872] c22 N72-21659
**REACTOR TECHNOLOGY**
Calculation of critical fuel mass for coaxial-flow gas-core reactors for specific conditions of operation
[NASA-TM-X-2534] c22 N72-21646
Insulation tests for prestressed concrete reactor vessels of water reactors
[CONF-710903-6] c22 N72-21652
**REAL TIME OPERATION**
Development of system for near real time automatic recognition of spoken words
[AD-735723] c07 N72-21182
Generation and checkout of computer programs for real time control of aerospace vehicles
c08 N72-21215
**RECORDING HEADS**
Development of methods for determining coefficient of friction and extent of stick-slip friction of magnetic recording tapes
[NASA-CR-125930] c07 N72-21154
**RECOVERY PARACHUTES**
Low altitude airdrop system using inflation-aided recovery parachutes for extraction
[AD-735375] c02 N72-21013
**RECTIFIERS**
Transient response analysis of single phase bridge rectifier circuit
[RAE-LIB-TRANS-1620] c10 N72-21273
**REFERENCE SYSTEMS**
Automatic frequency control device for providing frequency reference for voltage controlled oscillator
[NASA-CASE-KSC-10393] c09 N72-21247
Reference file for aiding weather forecasts at Loredo AFB, Texas
[AD-735791] c20 N72-21615
**REFLECTANCE**
Verification of Franz-Keldysh theory predictions as shown by interference of light and heavy hole contributions to electroreflectance spectrum of germanium
c26 N72-21754
Measurement of changes in reflectivity upon alloying of small amounts of Ag, Cu, and Fe into Au
c26 N72-21769
**REFLECTION**
Reflection from radially inhomogeneous spherical shells
[AD-736630] c23 N72-21674
**REFLECTORS**
Tradeoffs and requirements for GEOS-C laser cube-corner reflector panels to give stronger returns at lower elevation angles and reduce pulse spread in return
[NASA-TM-X-65862] c31 N72-21890
**REFRACTION**
Ionospheric refraction effect on geometry of field aligned ionization at HF and UHF in Northern Hemisphere
c07 N72-21152
**REFRACTORY MATERIALS**
Process for making semiconductor devices with refractory dielectrics as diffusant masks
[NASA-CASE-XER-08476-2] c26 N72-21800
**REFRACTORY METAL ALLOYS**
Creep strength reduction in strain-aging refractory alloys by applying low-amplitude, high-frequency fatigue vibrations during creep tests
[NASA-CR-120891] c17 N72-21529
**REGENERATIVE FUEL CELLS**
Vapor cycle engine for driving Pu 238 fueled heart assist system
[PB-205474] c05 N72-21086
**REGGE POLES**
Angular behavior of K/Pi ratio at high energy in multi-Regge model
[NOTA-INTERNA-338] c24 N72-21688
**REINFORCED PLASTICS**
Fabrication of carbon fiber composites using high temperature phenylated polyquinoxaline
[AD-735876] c18 N72-21563
Activity report for 1970 on mechanical engineering, metallurgy, metallography, selective dissemination of information, and plastics
c34 N72-21976
**REINFORCING FIBERS**
Unified and rational treatment of theory for fiber reinforced composite materials
[NASA-CR-1974] c32 N72-21932
**RELATIVISTIC THEORY**
One-dimensional Dirac equation solved for Kronig-Penney model containing delta-potential impurity
c26 N72-21761
**RELIABILITY ANALYSIS**
Statistical errors in estimating density of states curves from energy band calculations, using aluminum data
c26 N72-21797
**REMOTE CONTROL**
Tests of remote automatic multipurpose station early warning system telemetry transmissions
[AD-736221] c07 N72-21195
Passive and active spacecraft control noting data transmission and processing methods
c07 N72-21299
**REMOTE HANDLING**
Remote handling device for mixing or analyzing dangerous chemicals
[NASA-CASE-LAR-10634-1] c15 N72-21476
**REMOTE SENSORS**
Development of active and passive techniques for detecting and measuring presence and intensity of wingtip vortices generated in airport areas
[DOT-TSC-FAA-72-13] c02 N72-20999
Design, development, and characteristics of remote sensing systems and display devices for aerial reconnaissance and radar imagery
[AD-735752] c07 N72-21188
Application of infrared sensing techniques to water exploration
[NASA-CR-126025] c13 N72-21357
Classification modes for multidisciplinary, high data rate requirements of ERTS satellites
[NASA-CR-126024] c13 N72-21358
Remote detection of fog banks using lidar backscattering and infrared radiometry
[PB-204805] c14 N72-21451
Survey of techniques for determining meteorological data by remote sensing from automatic data buoy platforms
[PB-204793] c14 N72-21452
**RESCUE OPERATIONS**
Evaluation of computerized simulation technique for developing search and rescue operational effectiveness
[AD-735418] c11 N72-21305
Military requirements, criteria, and force structure for Coast Guard search and rescue operations
[AD-735408] c34 N72-21989

**RESEARCH AND DEVELOPMENT**
Research and development on aeronautics, biochemistry, and geophysics
[AD-735897] c34 N72-21987
**RESEARCH FACILITIES**
Organization and operation of US Air Force Test Pilot School
c11 N72-20994
Analysis of Langley Research Center activities, geography, geology, and climate to determine sources of environmental pollution
[NASA-TM-X-67680] c11 N72-21285
Analysis of NASA-Ames Research Center activities, geography, geology, and climate to determine sources of environmental pollution
[NASA-TM-X-67669] c11 N72-21286
**RESIDUAL GAS**
Computer program for calculating partial pressure of selected gases from residual gas analyzer ion spectra
[NASA-CR-125938] c06 N72-21096
**RESISTOJET ENGINES**
Specification for performance, design, fabrication, test and quality assurance for electrothermal hydrazine thrustor
[NASA-CR-122377] c28 N72-21820
**RESONANT FREQUENCIES**
Resonant frequency of linearly elastic, horizontally layered systems
[PB-205260] c13 N72-21396
Planetary resonance structure, sunspot activity, and bistable modes of solar oscillation
[NASA-CR-2035] c30 N72-21870
**RESONATORS**
Resonators for diplexers in multiplexing network noting bandpass filters and coplanar waveguides
[ESRO-CR-46] c07 N72-21164
**RESPIRATION**
Response of ventilation parameters, pulse rate, oxygen uptake, and body temperature in man under acute and severe hypoxia
[DLR-FB-71-65] c04 N72-21053
Whole body plethysmograph system for use in measuring airway resistance under ambient hyperbaric conditions for normal breathing patterns
[AD-735462] c05 N72-21081
**RESPIRATORY DISEASES**
Lactate-pyruvate and redox state responses of blood and tissue in chronic hypercapnia
[AD-734120] c04 N72-21057
Plasma creatine phosphokinase response to hypercapnia
[AD-734126] c04 N72-21058
Electromyographic measurement of maximum voluntary muscle contraction endurance in chronic hyperventilators
[AD-734298] c04 N72-21072
**RESPONSES**
System for monitoring condition-responsive devices by using frequency division multiplex technique
[NASA-CASE-KSC-10521-1] c07 N72-21160
**RHENIUM**
Rhenium adsorption in activated carbons
[NASA-TT-F-14250] c17 N72-21535
**RHENIUM ALLOYS**
Measurement of low temperature specific heats of fcc Ru-Rh and Rh-Pd alloys
c26 N72-21774
**RIESZ THEOREM**
Polynomials orthogonal to holomorphic functions of many complex variables and analog of Riesz-Fischer theorem
[NLL-M-22038-[5828.4F]] c19 N72-21566
**RING CURRENTS**
Development of theory for formation of stable auroral red arcs at plasmapause
[AD-736431] c13 N72-21403
**RING STRUCTURES**
Electron microscope and method of making annular objective aperture
[NASA-CASE-ARC-10448-1] c14 N72-21421
One dimensional analysis of expansion of gas cloud into vacuum to determine cause of ring structure of neutral gas cloud during barium cloud experiments
[NASA-TN-D-6760] c30 N72-21859
**RIOMETERS**
Spatial correlation of auroral radio absorption, using riometers
c07 N72-21146
**ROCKET EXHAUST**
Computer codes for predicting effect of rocket exhaust plume impingement on sensitive space vehicle surfaces
[AD-735722] c33 N72-21962
**ROCKET LAUNCHING**
Meteorological and ballistics data for launching of Lance missile 2105, round 134
[AD-735357] c20 N72-21618
**ROCKET SOUNDING**
Centaur sounding rocket Wadsworth spectrograph experimental design for auroral emission spectrophotographic recording
[ESRO-SM-80] c14 N72-21444
**ROCKS**
Elastic wave velocity and attenuation, gamma ray absorption, and thermal conductivity in rocks of interest to seismologists
c13 N72-21340
Paleomagnetism, archeomagnetism, magnetic properties of rocks and minerals, and geomagnetic field models
c13 N72-21347
**RODS**
Pressure loss and heat transfer for electrically heated rough rods in concentric smooth tubes
[NP-19112] c22 N72-21649
**ROOTS OF EQUATIONS**
Organization of digital computer program for finding root locus of linear, single loop systems
[DLR-FB-71-64] c19 N72-21569
**ROTARY WING AIRCRAFT**
Compilation of accidents involving helicopters and rotor craft for United States general aviation operations during 1969
[PB-204812] c02 N72-21024
Doppler discrimination in high background noise of rotary winged aircraft
[AD-734118] c04 N72-21056
**ROTARY WINGS**
Application of programmed pilotage techniques to vary aerodynamic parameters during flight for enhancement of level flight speed characteristics of VTOL aircraft
[AD-736537] c02 N72-21032
**ROTATION**
Positioning mechanism for converting translatory motion into rotary motion
[NASA-CASE-NPO-10679] c15 N72-21462
**RUBIDIUM COMPOUNDS**
Neutron diffraction and Mossbauer studies of hexagonal linear chain compound, RbFeCl3
[BNL-16327] c06 N72-21106
Magnetic hyperfine structure and Mossbauer effect in rubidium and potassium fluorides
[BNL-16326] c06 N72-21107
**RUBY**
Application of group theory to calculation of influence of electric field on electron paramagnetic resonance spectrum in ruby
[AD-735814] c26 N72-21807
**RUBY LASERS**
Holographic recording of limestone pollution by back or side scattering of ruby laser beam
[PB-205189] c14 N72-21457
**RUNWAY CONDITIONS**
Computer program and numerical analysis of feasibility of using suction between and along runways to remove trailing edge vortex streets
[IDA-LOG-HQ-69-10164] c11 N72-21290
**RUNWAYS**
Tests to determine design feasibility of unsurfaced soil facilities for operations of C-5A aircraft
[AD-735344] c13 N72-21398
**RUTHENIUM ALLOYS**
Measurement of low temperature specific heats of fcc Ru-Rh and Rh-Pd alloys
c26 N72-21774


## S


**S MATRIX THEORY**
Evaluation of excluded terms in multiple scattering series for electron in presence of several impurities
c26 N72-21766
**S WAVES**
Amplitude epicenter distance curves of P and S waves used to determine upper mantle structure of Southeastern Europe
c13 N72-21338
**SAFETY DEVICES**
Safe pressurized lighting system for operating in hazardous environments
[NASA-CASE-KSC-10644-1] c09 N72-21250
Methods of measuring vehicle occupant motion during crash or impact and evaluation of restraint system performance
[PB-204809] c14 N72-21447
Analysis of methods for measuring vehicle occupant motion during crash or impact and evaluation of restraint system performance
[PB-204808] c14 N72-21448
**SAFETY MANAGEMENT**
Mathematical models for predicting safety margins in planetary quarantine
[NASA-CR-126032] c04 N72-21050
Measurement and control of radioactive wastes in environment, soil, and water
[CONF-711113-3] c22 N72-21653
Effects of radioactive wastes from nuclear power generation on environment
[CONF-711113-2] c22 N72-21658
**SANDS**
Relationship between sand flow and wind friction, and vertical density distribution of sand
[NASA-TT-F-14215] c13 N72-21359
**SANDWICH STRUCTURES**
Method for preparing laminates of stressed face sandwich structures with light weight cores
[NASA-CASE-XLA-11028] c15 N72-21486
**SATELLITE ATTITUDE CONTROL**
Method and apparatus for providing active attitude control for spacecraft by converting any attitude motion of vehicle into simple rotational motion
[NASA-CASE-HQN-10439] c21 N72-21624
**SATELLITE CONTROL**
Control, tracking, data acquisition, and processing relating to ESRO satellites
c11 N72-21292
Satellite control noting CNES ground station network
c11 N72-21297
**SATELLITE GROUND SUPPORT**
Control, tracking, data acquisition, and processing relating to ESRO satellites
c11 N72-21292
**SATELLITE INSTRUMENTS**
Tests of proposed ballistic wind determination technique using SIRS data from Nimbus 3 and 4 satellites
[AD-735898] c13 N72-21393
Economical satellite aided vehicle avoidance system for preventing midair collisions
[NASA-CASE-ERC-10419] c21 N72-21631
**SATELLITE NETWORKS**
Spacecraft control, satellite networks, and ground support in European space programs
[ESRO-SP-66] c11 N72-21296
Satellite control noting CNES ground station network
c11 N72-21297
Satellite tracking, telemetry, and command network control and procedures noting operating system, data requirements, and orbital elements
c11 N72-21300
**SATELLITE ORBITS**
Geoid and gravity data based on satellite orbital elements
c13 N72-21333
Solar radiation, cosmic rays, satellite orbits, and upper atmosphere structure - bibliography
c34 N72-21975
**SATELLITE PERTURBATION**
Computation of nearly circular satellite orbit perturbation due to geopotential harmonics
[ESRO-SR-13] c30 N72-21873
Computer programming for determining moderate-to-highly eccentric satellite launch window considering satellite perturbations
[ESRO-SR-15] c30 N72-21874
**SATELLITE TRACKING**
Geomagnetism, satellite tracking, oceanography, hyperbolic navigation, and radio equipment research projects
[AD-735169] c21 N72-21639
**SATELLITES**
Ionospheric irregularities causing high latitude satellite scintillation
c07 N72-21140
**SATURN S-2 STAGE**
Documenting welding skills acquired during Saturn S-2 Program
[NASA-CR-123487] c15 N72-21468
**SATURN 1B LAUNCH VEHICLES**
Computerized simulation of Skylab 1B vehicle response to winds during propellant loading at launch pad for determining displacements and bending moments
[NASA-CR-123564] c31 N72-21878
**SCALE MODELS**
Longitudinal and lateral aerodynamic characteristics of scale model of GD/C aerospace shuttle booster in wind tunnel force tests
[NASA-CR-119992] c31 N72-21886
**SCANDIUM**
Structure of d-band for Sc, Ti and Zr in 4 to 11.6 eV range by photoemission spectroscopy
c26 N72-21726
**SCANNERS**
High speed scanner for measuring mass of preselected gases at high sampling rate
[NASA-CASE-LAR-10766-1] c14 N72-21432
**SCANNING**
Scanning characteristics of near field Cassegrainian antenna excited with small planar array
[AD-735661] c09 N72-21264
**SCATTERING**
Evaluation of Jacobian determinants occurring in classical mechanical and quasiclassical approximation descriptions of molecular scattering
[NASA-CR-125978] c06 N72-21095
Size and shape determination of conducting body causing electromagnetic field scattering
[AD-735287] c07 N72-21170
**SCHOOLS**
Organization and operation of US Air Force Test Pilot School
c11 N72-20994

Procedures for training pilots in assessment of flight systems during attendance at Empire Test Pilot School, England
c11 N72-20995

Organization, operation, and curriculum of U.S. Navy Test Pilot School at Patuxent Naval Air Station, Maryland
c11 N72-20996

**SCIENTIFIC SATELLITES**
Summary of Phase A of High Energy Astronomy Observatory Mission-C
[NASA-TM-X-64652-VOL-1] c11 N72-21282

Analysis and conceptual design of baseline mission and spacecraft for HEAO-C
[NASA-TM-X-64652-VOL-2] c11 N72-21283

**SCIENTISTS**
Opportunities in naval research, benefiting both Navy and Marine Corps
[AD-734183] c34 N72-21979

**SCINTILLATION**
High latitude studies of scintillation in radio signals from radio sources and satellites
c07 N72-21137

Intensity variations in satellite scintillations in F region
c07 N72-21138

Ionospheric irregularities causing high latitude satellite scintillation
c07 N72-21140

HF auroral backscatter, scintillation theory, and satellite beacon recordings
c07 N72-21150

**SCREEN EFFECT**
Behavior of electron wave functions near atomic nucleus and normalization screening theory in atomic photoeffect
[NYO-3829-75] c24 N72-21678

**SEA ICE**
Arctic research including studies of ice albedo, acoustic telemetry, and ice pack support vehicle
[AD-735957] c13 N72-21383

Ice conditions and surface profiles in Arctic Ocean
[AD-735871] c13 N72-21389

**SEA WATER**
High energy density sea water battery
[AD-735864] c03 N72-21038

Precracked cantilever beam and long term beam exposure tests for determining stress corrosion of Al alloys in sea water
c17 N72-21919

**SEALS [STOPPERS]**
Pressure tight seal for superalloy used in hypersonic aircraft fuel tank joints
[NASA-CASE-LAR-10170-1] c15 N72-21471

Announcing aerospace developments in seals and sealing techniques for technology utilization in other industries
[NASA-SP-5905(03)] c15 N72-21480

**SECURITY**
System security hardware, software, and procedural techniques in automated systems
[AD-735728] c08 N72-21234

Data base security and access limitation requirements for post 1975 automated TACC complex with tabulated security data
[AD-735729] c08 N72-21235

Security and access limitation problems in automated systems, TACC data baseline, and TACC user identification
[AD-735730] c08 N72-21236

Lists of data users, acronyms, and abbreviations in TACC data base
[AD-735731] c08 N72-21237

Growth capabilities and future automation of TACC data base security and limitation requirements
[AD-735732] c08 N72-21238

**SEISMIC WAVES**
Three dimensional seismic models of upper mantle using multicomponent gels to produce continuous variations in wave velocity
c13 N72-21339

Computer programming for interpreting and processing seismic wave data related to earth crust and upper mantle
c13 N72-21341

Deep seismic sounding data and natural seismic noise along international profile 6, and preliminary data along profiles 5 and 7, Czechoslovakia
c13 N72-21342

Tilt steps associated with local, regional and distant earthquakes
[RLO-2229-T-4-1] c13 N72-21367

Analysis of earthquake-explosion seismographic data based on results from seismic detection and earth noise investigations
[AD-735765] c13 N72-21399

**SEISMOLOGY**
Gravity anomalies, seismic data, geomagnetism, and electrical conductivity of earth crust and upper mantle, and specific data for Czechoslovakia
c13 N72-21329

Earthquake magnitudes, frequencies, and active regions in Europe
c13 N72-21337

Elastic wave velocity and attenuation, gamma ray absorption, and thermal conductivity in rocks of interest to seismologists
c13 N72-21340

Correlation between deflections of verticals and axes of zones of increased macroseismic mobility, and agreement with tectonic dislocation lines
c13 N72-21346

Computer programs for elastic wave propagation code to analyze ground motions from vertically oriented nuclear detonations
[NVO-1163-227] c13 N72-21371

Analysis of earthquake-explosion seismographic data based on results from seismic detection and earth noise investigations
[AD-735765] c13 N72-21399

**SEMICONDUCTOR DEVICES**
Application of position-sensitive semiconductor detectors to study heavy element nuclear reactions at intermediate energies
[MNC-3783-10] c14 N72-21442

Process for making semiconductor devices with refractory dielectrics as diffusant masks
[NASA-CASE-XER-08476-2] c26 N72-21800

Fabrication and experimental analysis of metal insulator semiconductor devices for radiation vulnerability studies
[AD-735947] c26 N72-21804

**SEMICONDUCTOR JUNCTIONS**
Hydrogenation effects on electron tunneling characteristics of aluminum-oxide-palladium junctions
c26 N72-21789

**SEMICONDUCTOR LASERS**
Applications of semiconductor diode lasers including use in construction of fast operating logic circuit elements
[AD-735463] c16 N72-21506

**SEMICONDUCTORS [MATERIALS]**
Calculating electron density of states using self-consistent orthogonalized plane wave model for compounds in isoelectronic sequences Si-AlP and Ge-GaAs-ZnSe
c26 N72-21714

Measurement of electroreflectance spectra of semoconductor materials for identification of energy multiplets and spin-orbit splittings
c26 N72-21753

Localized electron density of states in narrow band and amorphous semiconductor crystalline solids
c26 N72-21763

Tunneling measurements of superconduction quasiparticle density of states of metals and semiconductors, and calculation of phonon spectra
c26 N72-21781

Band structure and density of states in zincblende-type semiconductors used to calculate nonlinear optical susceptibility responsible for second harmonic generation
c26 N72-21792

1/f noise distribution in semiconductors
[AD-735944] c26 N72-21805

**SENSORS**
Development and characteristics of balloon interrogation package for use with Nimbus 4 satellite
[NASA-CR-122375] c14 N72-21410

Development of sensors for detecting amount of ablation over ablating surfaces and change in boundary layer flow conditions
[NASA-CASE-LAR-10439-1] c33 N72-21956

**SEQUENTIAL ANALYSIS**
Mathematical models for analyzing sequential and continuous motor behavior in humans
[AD-734681] c04 N72-21060

**SEQUENTIAL CONTROL**
Problem of representing groups of loosely connected processes and model for process representation useful for synthesizing complex patterns of process behavior
[NASA-CR-122379] c08 N72-21207

**SERVICE LIFE**
Performance characteristics and service life of silver oxide-zinc battery for synchronous orbit and planetary missions
[NASA-TM-X-68036] c03 N72-21034

Service life of electromechanical device for generating sine/cosine functions
[NASA-CASE-LAR-10503-1] c09 N72-21248

Life tests for SNAP 23A fueled prototype mockup system
[WANL-4219-1] c22 N72-21656

**SERVOMECHANISMS**
Design, development, and characteristics of variable delivery, positive displacement fuel pump for use with J-85 turbine engine fuel system
[AD-735259] c15 N72-21496

**SET THEORY**
Numerical analysis of lower bound for sorting networks based on divide-sort-merge strategy
[AD-735901] c10 N72-21280

**SHELLS [STRUCTURAL FORMS]**
Finite element method for current shell analysis capability
[AD-735726] c32 N72-21941

**SHELTERS**
Equipment mounting capability, safeguard against delamination of outer skin, and weight maintainance of shelter electrical equipment
[AD-735280] c32 N72-21940

**SHIFT REGISTERS**
Commutator for steering precisely controlled bidirectional currents through numerous loads by use of magnetic core shift registers
[NASA-CASE-NPO-10743] c08 N72-21199

**SHIPS**
Application of communication satellites to provide worldwide maritime communication system
[PB-204860] c07 N72-21191

**SHOCK HEATING**
Investigation of high Mach number collisionless electrostatic shocks in plasmas
[IPPJ-119] c25 N72-21692

Weak solar wind shock heating of comet coma and Venus atmosphere
[TRITA-EPP-72-02] c29 N72-21851

**SHOCK RESISTANCE**
Processing methods for model quartz crystal units with equivalent circuit parameters and high shock resistance
[AD-735685] c26 N72-21808

**SHOCK TUBES**
Development and characteristics of shock tube for analyzing argon plasma optical properties
[FRNC-TH-70] c11 N72-21302

Heat conductivity of argon in shock tubes at 5000 K
[NLL-M-22129-[5828.4F]] c33 N72-21950

**SHOCK WAVES**
Lifting airfoils with supercritical shock-free flow
[NLR-MP-70015-U] c01 N72-20972

Vibrational relaxation for gaseous mixtures of CO and Ar using rapid heating and cooling rates
[DLR-FB-71-62] c12 N72-21315

Effect of wave overtaking on peak pressure of refracted underwater explosion shock waves
[AD-735875] c12 N72-21324

Prediction theories for shock wave attenuation in porous materials
[AD-735761] c12 N72-21326

**SHORT TAKEOFF AIRCRAFT**
Numerical analysis of aircraft noise created by externally blown flaps on STOL aircraft and methods for noise reduction
[NASA-TM-X-68047] c02 N72-21001

**SHORT WAVE RADIATION**
Determination of atmospheric absorption coefficient in shortwave region of decimeter range
[NLL-M-22050-[5828.4F]] c13 N72-21349

**SIDELOBE REDUCTION**
Designing filters for detection and estimation in radar and communications systems with inequality constraints on maximum output sidelobes
[NASA-CR-125935] c07 N72-21120

**SIGNAL DETECTION**
Signal detection, communication theory, parameter estimation, and network analysis
[AD-735760] c07 N72-21181

Bit detection methods and detectors for FSK and PSK modulated data
c07 N72-21294

Microphone array for detection and recording of infrasound
[KGO-TR-71-105] c14 N72-21445

**SIGNAL PROCESSING**
Design and characteristics of recording system for selective reprocessing and filtering of data to obtain optimum signal to noise ratios
[NASA-CASE-ERC-10112] c07 N72-21119

Survey of digital signal processing techniques for speech analysis
[AD-735919] c07 N72-21184

Digital signal processing algorithms useful in speech research
[AD-735921] c07 N72-21185

Waveform processing system as flexible on-line graphic interactive tool for signal classification
[AD-735749] c08 N72-21241

Utilization of militarized computers for target acquisition and surveillance signal processing applications
[AD-735327] c08 N72-21242

**SIGNAL REFLECTION**
Effectiveness of system for towing deep submerged hydrophone array
[AD-735885] c23 N72-21671

**SIGNAL TO NOISE RATIOS**
Design and characteristics of recording system for selective reprocessing and filtering of data to obtain optimum signal to noise ratios
[NASA-CASE-ERC-10112] c07 N72-21119

Effects of external noise on angular resolution of highly directional radar antenna
c07 N72-21157

**SIGNAL TRANSMISSION**
Propagation loss, spectral spreading, and temporal spreading of high altitude HF signal transmission
c07 N72-21144

Signal propagation at 400 kHz in oak trees using HEMAC
[AD-735330] c07 N72-21178

**SILICATES**
Nonflammable coatings of synthetic mica and silicate gelant solution mixed with latex paint for use in liquid oxygen or high oxygen gaseous atmospheres
[NASA-CASE-MFS-20486] c18 N72-21557

**SILICON**
Very high resolution X ray spectrometry with cooled Si[Li] detectors and optoelectron preamplifier
[CEA-CONF-1840] c14 N72-21439

**SILICON COMPOUNDS**
Process for preparing disilanols with in-chain perfluoroalkyl groups
[NASA-CASE-MFS-20979-2] c06 N72-21101

**SILICON JUNCTIONS**
Metal-semiconductor barrier junction tunneling study of heavily doped n-type silicon density of states function
c26 N72-21784

**SILOXANES**
Polyimide foams produced in presence of alkanolamine or siloxane-glycol polymer
[NASA-CASE-ARC-10464-1] c06 N72-21102

**SILVER**
Measurement of changes in reflectivity upon alloying of small amounts of Ag, Cu, and Fe into Au
c26 N72-21769

**SILVER ALLOYS**
Photoelectric emission technique used to study density of states of three silver based alloys
c26 N72-21770

**SILVER COMPOUNDS**
Synthesis of thin silver sulfide films and measurement of electrical properties when used as cathode in solid electrolyte electrical cell
[NASA-TT-F-14196] c03 N72-21035

**SILVER OXIDES**
Preparation and crystal structure of KAgO and CsAgO
[NASA-TT-F-14192] c26 N72-21799

**SILVER ZINC BATTERIES**
Performance characteristics and service life of silver oxide-zinc battery for synchronous orbit and planetary missions
[NASA-TM-X-68036] c03 N72-21034
Zinc silver oxide secondary battery failure during cycle life tests
[AD-736016] c03 N72-21040

**SIMULATION**
Simulation and investigation of scattering mechanisms of radio aurora
c07 N72-21135
Bibliography of reports and simulation models describing air traffic control procedures for all phases of aircraft operation
[DOT-TSC-FAA-71-7] c21 N72-21626

**SINE SERIES**
Service life of electromechanical device for generating sine/cosine functions
[NASA-CASE-LAR-10503-1] c09 N72-21248
Function generator for producing complex vibration mode patterns used to identify vibration mode data
[NASA-CASE-LAR-10310-1] c10 N72-21275

**SIZE DETERMINATION**
Size and shape determination of conducting body causing electromagnetic field scattering
[AD-735287] c07 N72-21170

**SKIN TEMPERATURE (BIOLOGY)**
Assessment of human skin temperature rise suppression by edge losses during thermal irradiation
[AD-735881] c04 N72-21069

**SKY WAVES**
Capability of navigation satellite system for predicting ionospheric conditions for optimum transmitting parameters in high frequency sky wave telecommunication
[AD-735866] c07 N72-21174

**SKYLAB PROGRAM**
Development of rotation law for application to Skylab gyroscopes to avoid gimbal stop encounters
[NASA-CR-126140] c21 N72-21633
Computerized simulation of Skylab 1B vehicle response to winds during propellant loading at launch pad for determining displacements and bending moments
[NASA-CR-123564] c31 N72-21878

**SLEEP**
Characteristics of heart rate information during sleep, and extracting sleep information from heart rate data
[AD-734283] c04 N72-21061

**SLENDER WINGS**
Comparison of flight test and wind tunnel data to determine areas of agreement when nonlinearities appear in aerodynamic coefficients of slender wing aircraft
c02 N72-20990

**SMOKE TRAILS**
Wind velocity profiles measured by smoke trail technique at Eastern Test Range during 1964
[NASA-TN-D-6746] c20 N72-21589

**SNAP 23**
Life tests for SNAP 23A fueled prototype mockup system
[WANL-4219-1] c22 N72-21656

**SOCIAL FACTORS**
Effects of atmospheric odorous exposure on community health and annoyance reactions
[PB-204989] c20 N72-21598

**SODIUM**
Oxygen effects in static sodium on vanadium and vanadium alloys, using internal oxygen theory
[ORNL-4739] c06 N72-21108
Application of Compton scattering effect for measuring ground state electronic linear momentum distribution function for lithium and sodium
c26 N72-21746

**SOIL MECHANICS**
Potential application of nuclear measuring techniques for soil density and moisture content at depth
[AD-735448] c13 N72-21395
Numerical analysis of cone angle effects on penetration resistance in soils
[AD-735788] c14 N72-21460
Effect of pore pressures on soil-wheel interaction
[AD-735792] c32 N72-21942

**SOILS**
Water movement through surface soil layers
[NASA-TT-F-14247] c13 N72-21360
Potential application of nuclear measuring techniques for soil density and moisture content at depth
[AD-735448] c13 N72-21395
Tests to determine design feasibility of unsurfaced soil facilities for operations of C-5A aircraft
[AD-735344] c13 N72-21398
Penetrometer for empirically determining load-bearing characteristics of inclined surfaces of remotely located bodies of soil
[NASA-CASE-NPO-11103] c14 N72-21406
Measurement of soil moisture content using wire wound strip heater inserted in ground
[NASA-TT-F-14265] c14 N72-21414
Measurement and control of radioactive wastes in environment, soil, and water
[CONF-711113-3] c22 N72-21653

**SOLAR ARRAYS**
Technological improvements for reducing costs of solar cells and solar arrays
[NASA-TM-X-68035] c03 N72-21033

**SOLAR ATMOSPHERE**
Analysis of strongest solar ultraviolet emission lines of Mg II, O I, C II, AND C III and atmospheric model development
[NASA-CR-125981] c29 N72-21829

**SOLAR CELLS**
Technological improvements for reducing costs of solar cells and solar arrays
[NASA-TM-X-68035] c03 N72-21033
Electrically conducting solar cell doped metal oxide transparent coating for Aeros satellite equipotential surface
c18 N72-21558
Solar proton radiation damage of solar cells at synchronous altitudes
c03 N72-21847

**SOLAR CORPUSCULAR RADIATION**
Simultaneous IMP 6 observations of anisotropic packet of low-energy solar electron intensities and of type 3 solar radio burst
[NASA-CR-125932] c29 N72-21828
Solar electron and proton measurements in interplanetary space and magnetotail during onset of solar particle event, and comparison with continuous transpolar VLF data
[AD-736430] c29 N72-21855

**SOLAR COSMIC RAYS**
Satellite solar cosmic ray particle identifier using field effect transistor analog amplifier for Explorer 34 and 41 spacecraft
c29 N72-21832
Measurements of low energy solar cosmic ray O/He, Si/He, and Fe/He ratios during Jan. 25, 1971 solar flare event
c29 N72-21846

**SOLAR FLARES**
Influence of solar flare on earth atmosphere
[NLL-M-22221-[5828.4F]] c13 N72-21351
Simultaneous IMP 6 observations of anisotropic packet of low-energy solar electron intensities and of type 3 solar radio burst
[NASA-CR-125932] c29 N72-21828
Analysis of solar flare particle measurements by Explorer 34 and 41 satellites
[NASA-CR-122389] c29 N72-21831
Low energy solar protons and alpha particles detected during 1967 solar flare used to probe properties of interplanetary space
c29 N72-21838
Low energy solar alpha to solar proton flux ratios observed following three solar flares of May 23, 1967
c29 N72-21840
Semiconductor particle telescope measurements of electron, proton, and alpha particle fluxes produced by Nov. 1969 west limb flare
c29 N72-21841
Explorer 34 measurements of low energy protons and alpha particles emitted during east limb solar flares
c29 N72-21842
Explorer 34 measurements of solar protons, electrons, and alpha particles during extreme west hemisphere 1B solar flare of Nov. 18, 1968
c29 N72-21844
Measurements of low energy solar cosmic ray O/He, Si/He, and Fe/He ratios during Jan. 25, 1971 solar flare event
c29 N72-21846
Ground and spacecraft observations of flare protons, alpha particles, and electrons
c29 N72-21848

**SOLAR PROBES**
Transmitter receiver system for Helios solar probe using coherent phase modulation
c07 N72-21162

**SOLAR PROTONS**
Analysis of solar flare particle measurements by Explorer 34 and 41 satellites
[NASA-CR-122389] c29 N72-21831
Penetration of low energy solar protons and alpha particles in interplanetary space and magnetosphere to magnetic equator
c29 N72-21833
Penetration of high energy solar protons to ionospheric heights at magnetic equator
c29 N72-21834
Temporal structure of solar protons detected in outer magnetosphere, interplanetary space, at synchronous altitude, and magnetotail
c29 N72-21835
Temporal and spectral changes in access of solar protons and alpha particles to synchronous altitude inside magnetosphere
c29 N72-21836
Access of solar protons and electrons to magnetotail and north polar cap
c29 N72-21837
Low energy solar protons and alpha particles detected during 1967 solar flare used to probe properties of interplanetary space
c29 N72-21838
Comparison of energetic storm protons and halo protons based on Explorer 34 data
c29 N72-21839
Low energy solar alpha to solar proton flux ratios observed following three solar flares of May 23, 1967
c29 N72-21840
Semiconductor particle telescope measurements of electron, proton, and alpha particle fluxes produced by Nov. 1969 west limb flare
c29 N72-21841
Explorer 34 measurements of low energy protons and alpha particles emitted during east limb solar flares
c29 N72-21842
Explorer 34 measurements of interplanetary solar protons and alpha particles during Oct. 26 through Nov. 1, 1968
c29 N72-21843
Explorer 34 measurements of solar protons, electrons, and alpha particles during extreme west hemisphere 1B solar flare of Nov. 18, 1968
c29 N72-21844
Interplanetary proton and electron data used to study association of particle data with type 3 solar radio bursts in dekametric band
c29 N72-21845
Solar proton radiation damage of solar cells at synchronous altitudes
c03 N72-21847
Ground and spacecraft observations of flare protons, alpha particles, and electrons
c29 N72-21848

**SOLAR RADIATION**
Proceedings of institute for aurora and airglow investigations during 1970
[AD-735151] c13 N72-21384
Solar radiation, cosmic rays, satellite orbits, and upper atmosphere structure - bibliography
c34 N72-21975

**SOLAR SPECTRA**
Analysis of strongest solar ultraviolet emission lines of Mg II, O I, C II, AND C III and atmospheric model development
[NASA-CR-125981] c29 N72-21829

**SOLAR SPECTROMETERS**
Satellite solar cosmic ray particle identifier using field effect transistor analog amplifier for Explorer 34 and 41 spacecraft
c29 N72-21832

**SOLAR STORMS**
Comparison of energetic storm protons and halo protons based on Explorer 34 data
c29 N72-21839

**SOLAR WIND**
Weak solar wind shock heating of comet coma and Venus atmosphere
[TRITA-EPP-72-02] c29 N72-21851

**SOLAR X-RAYS**
Solar X-ray and magnetospheric data from OV5-1
[AD-735277] c29 N72-21852

**SOLID PROPELLANT IGNITION**
Stress-strain relation in solid rocket propellant by ignition
[ICT-10/70] c27 N72-21810
**SOLID PROPELLANT ROCKET ENGINES**
Characteristics of solid propellant rocket engines for delivering high thrust with short impulse duration
[AD-735381] c28 N72-21823
Performance test to determine effectiveness of third stage destruct system on Athena rocket vehicle propulsion system
[AD-735289] c28 N72-21826
**SOLID ROCKET PROPELLANTS**
Stress-strain relation in solid rocket propellant by ignition
[ICT-10/70] c27 N72-21810
Effectiveness of synergistic catalyst systems in altering ballistic parameters of composite solid propellants
[AD-736222] c27 N72-21814
**SOLID SOLUTIONS**
Thermodynamic and solid solution studies of nonferrous metallic compounds
[JPRS-55392] c17 N72-21517
Solubility of carbon in niobium c18 N72-21523
**SOLID STATE PHYSICS**
Scientific research in theoretical plasma, and solid state physics and communication and microwave transmission
[AD-735366] c23 N72-21673
**SOLIDS**
Role of solids thermal microwave noise in earth resources microwave radiometry
[RAC-0-3-R16] c07 N72-21163
**SONAR**
Doppler discrimination in high background noise of rotary winged aircraft
[AD-734118] c04 N72-21056
Models for sound propagation and reverberation, surface backscattering coefficients, and sonar performance prediction
[AD-735995] c13 N72-21390
Anticipatory sensing of impending automobile accidents using microwave radar and ultrasonic sonar
[PB-204806] c14 N72-21449
Finite element mathematical models for equations of motion of flexing head of BQS-6 transducer
[AD-735459] c16 N72-21505
**SOUND GENERATORS**
Case histories of international cooperation in field of ballistic ranges, sonic boom generators and simulation of nuclear blast in galleries
[ISL-4/71] c11 N72-21304
**SOUND PROPAGATION**
Wave equations for determining scattering of sound from layered hollow elastic cylinders
[AD-735859] c23 N72-21670
**SOUND TRANSMISSION**
Turbulent flow model for estimating sound level
[AD-735922] c12 N72-21327
Sound transmission impedance in cyclindrical steel shells
[NLL-M-22125-[5828.4F]] c23 N72-21660
**SOUND WAVES**
Spectrum analysis of internal acoustic gravity waves based on CW Doppler data
[NASA-CR-2033] c13 N72-21365
Acoustic and internal gravity wave propagation and turning points
[AD-735386] c13 N72-21381
Acoustic radiation from free-free, point drive beams affected by light and heavy fluid loading
[AD-735873] c32 N72-21944
**SOUND-SOUND INTERACTIONS**
Aircraft noise reduction by extinction with reversed phase sound in acoustic interference
[MBB-BB-55-71-O] c02 N72-21011
**SOUNDING ROCKETS**
Meteorological data for Lance launching
[AD-735364] c20 N72-21596
**SPACE COMMUNICATION**
Characteristics of ultrahigh frequency and very high frequency aircraft antennas for aircraft-satellite communications link
[PB-204799] c07 N72-21165
Characteristics of satellite-to-ground whistler mode communication link
[AD-736429] c07 N72-21194
**SPACE NAVIGATION**
Automatic vehicle control using navigation and guidance algorithms based on digital statistical data
[AD-735605] c21 N72-21637
**SPACE PROBES**
Role of meteoroids as interplanetary spaceprobes
[NASA-TT-F-13962] c30 N72-21862
**SPACE SHUTTLE BOOSTERS**
Longitudinal and lateral aerodynamic characteristics of scale model of GD/C aerospace shuttle booster in wind tunnel force tests
[NASA-CR-119992] c31 N72-21886
Low speed aerodynamic characteristics of GD/C B-18E3 space shuttle booster
[NASA-CR-120035] c31 N72-21888
Aerodynamic wind tunnel stability tests for determining fin deflection angle and vertical position of frustrum of space shuttle at high angles of attack
[NASA-CR-120040] c31 N72-21889
**SPACE SHUTTLES**
Software aspects of phase B space shuttle avionics system, emphasizing executive system design
[NASA-CR-115513] c08 N72-21204
Task, I/O, and configuration management of shuttle flight executive system
[NASA-CR-115514] c08 N72-21205
Wind tunnel balance system for determining wind-induced vibrations in space shuttle model
[NASA-CR-115531] c11 N72-21288
Ground and vehicle systems for liquid fluorine space shuttle
[AD-735290] c27 N72-21812
Potential cost reductions in operational ITOS weather satellite program by shuttle/tug availability
[NASA-CR-122398] c31 N72-21895
German participation in space shuttle design and development including preliminary low speed wind tunnel tests c31 N72-21898
Hot salt stress corrosion cracking of titanium alloys used as radiative heat shields in space shuttles
[NASA-TM-X-68304] c17 N72-21926
Effects of fabrication-induced defects on performance of ablative heat shield materials in simulated space shuttle reentry
[NASA-CR-2010] c33 N72-21954
**SPACE STATIONS**
Ventilation systems for 33-foot diameter space station and 14-foot diameter modular space station
[NASA-CR-123593] c31 N72-21879
Detailed data on modular initial space station configuration and on structural/mechanical, crew habitability and protection, and experiment support subsystems
[NASA-CR-123544] c31 N72-21880
Design data on electrical power, environmental control/life support, propulsion, and guidance, navigation, and control subsystems for modular space station
[NASA-CR-123545] c31 N72-21881
Design data on communications, data management, and onboard checkout subsystems, modular interfaces, and zero-gravity configuration for modular space station
[NASA-CR-123543] c31 N72-21882
Crew facilities and operations for modular space stations
[NASA-CR-121087] c31 N72-21883
Design, development, and project management of modular space station concept to include cost analyses and equipment specifications
[NASA-CR-123541] c31 N72-21884
Stability and control moment gyro wobble damping of flexible, spinning space stations, using digital computer program
[NASA-CR-115525] c31 N72-21892
Computer systems program specifications for modular space station information management system
[NASA-CR-121088] c34 N72-21967
**SPACE SUITS**
Optimization of fluidic temperature control for space suits based on flow visualization
[NASA-CR-115511] c14 N72-21426
**SPACEBORNE PHOTOGRAPHY**
Application of space photography for monitoring surface mining operations c13 N72-21362
**SPACECRAFT ANTENNAS**
Variable frequency microwave spacecraft antenna
[NASA-CASE-NPO-11264] c07 N72-21155
**SPACECRAFT CABIN ATMOSPHERES**
Ventilation systems for 33-foot diameter space station and 14-foot diameter modular space station
[NASA-CR-123593] c31 N72-21879
**SPACECRAFT COMMUNICATION**
Design data on communications, data management, and onboard checkout subsystems, modular interfaces, and zero-gravity configuration for modular space station
[NASA-CR-123543] c31 N72-21882
**SPACECRAFT COMPONENTS**
Design, development, and project management of modular space station concept to include cost analyses and equipment specifications
[NASA-CR-123541] c31 N72-21884
Development and application of single formula cost estimating relationships for determining costs of spacecraft platform components
[NASA-TM-X-68851] c31 N72-21894
Computer codes for predicting effect of rocket exhaust plume impingement on sensitive space vehicle surfaces
[AD-735722] c33 N72-21962
**SPACECRAFT CONFIGURATIONS**
Summary of Phase A of High Energy Astronomy Observatory Mission-C
[NASA-TM-X-64652-VOL-1] c11 N72-21282
Analysis and conceptual design of baseline mission and spacecraft for HEAO-C
[NASA-TM-X-64652-VOL-2] c11 N72-21283
Supporting technical data, and alternate experiments and spacecraft configurations for HEAO-C
[NASA-TM-X-64652-VOL-3] c11 N72-21284
Detailed data on modular initial space station configuration and on structural/mechanical, crew habitability and protection, and experiment support subsystems
[NASA-CR-123544] c31 N72-21890
**SPACECRAFT CONTAMINATION**
Portable vacuum surface probe for sampling spacecraft surface for microorganisms
[NASA-CASE-LAR-10623-1] c14 N72-21415
Material outgassing, vapor sorption, and thin film spreading at sources of spacecraft contamination and effects on spacecraft performance in ultrahigh vacuum c31 N72-21896
**SPACECRAFT CONTROL**
Spacecraft control, satellite networks, and ground support in European space programs
[ESRO-SP-66] c11 N72-21296
Philosophy of network management and spacecraft control at ESOC c11 N72-21298
Passive and active spacecraft control noting data transmission and processing methods c07 N72-21299
Satellite tracking, telemetry, and command network control and procedures noting operating system, data requirements, and orbital elements c11 N72-21300
Design, development, and qualification of Apollo lunar module reaction control system
[NASA-TN-D-6740] c31 N72-21887
**SPACECRAFT DESIGN**
Design, development, and project management of modular space station concept to include cost analyses and equipment specifications
[NASA-CR-123541] c31 N72-21884
Design, development, and characteristics of flight command system for Mariner Mars 1971
[NASA-CR-126038] c31 N72-21891
Development and application of single formula cost estimating relationships for determining costs of spacecraft platform components
[NASA-TM-X-68851] c31 N72-21894
German participation in space shuttle design and development including preliminary low speed wind tunnel tests c31 N72-21898
**SPACECRAFT ENVIRONMENTS**
Dual stage check valve for cryogenic supply systems used in space flight environmental control system
[NASA-CASE-MSC-13587] c15 N72-21483
**SPACECRAFT GUIDANCE**
Software and hardware technology for application of computer systems to guidance and control of aerospace vehicles
[AGARDOGRAPH-158] c08 N72-21211
Hardware organization and system design of guidance and control computers c08 N72-21214
Programming characteristics of future guidance and control computers c08 N72-21216
Fault isolation capabilities for general purpose digital computer used in guidance and control applications c08 N72-21220
Design data on electrical power, environmental control/life support, propulsion, and guidance, navigation, and control subsystems for modular space station
[NASA-CR-123545] c31 N72-21881
**SPACECRAFT INSTRUMENTS**
Spacecraft transponder and ground station radar system for mapping planetary surfaces
[NASA-CASE-NPO-11001] c07 N72-21118
Method and apparatus for providing active attitude control for spacecraft by converting any attitude motion of vehicle into simple rotational motion
[NASA-CASE-HQN-10439] c21 N72-21624
**SPACECRAFT LAUNCHING**
Impact of KSC operations on environment
[NASA-TM-X-67740] c11 N72-21289
**SPACECRAFT MODULES**
Detailed data on modular initial space station configuration and on structural/mechanical, crew habitability and protection, and experiment support subsystems
[NASA-CR-123544] c31 N72-21880
Design data on electrical power, environmental control/life support, propulsion, and guidance, navigation, and control subsystems for modular space station
[NASA-CR-123545] c31 N72-21881
Design data on communications, data management, and onboard checkout subsystems, modular interfaces, and zero-gravity configuration for modular space station
[NASA-CR-123543] c31 N72-21882
Crew facilities and operations for modular space stations
[NASA-CR-121087] c31 N72-21883

**SPACECRAFT PERFORMANCE**
Material outgassing, vapor sorption, and thin film spreading at sources of spacecraft contamination and effects on spacecraft performance in ultrahigh vacuum
c31 N72-21896

**SPACECRAFT POSITION INDICATORS**
Determination of relative angular position of spacecraft and radiating celestial body
[NASA-CASE-GSC-11444-1] c14 N72-21418

**SPACECRAFT POWER SUPPLIES**
Design and fabrication of three-phase helical induction electromagnetic pump for use as boiler-feed pump of potassium Rankine cycle space electric power system
[NASA-CR-1949] c15 N72-21479

**SPACECRAFT PROPULSION**
Development of procedure for calculating various interactions of ion thrusters with spacecraft surface
[NASA-TM-X-68043] c28 N72-21815
Design data on electrical power, environmental control/life support, propulsion, and guidance, navigation, and control subsystems for modular space station
[NASA-CR-123545] c31 N72-21881

**SPACECRAFT RECOVERY**
Potential cost reductions in operational ITOS weather satellite program by shuttle/tug availability
[NASA-CR-122398] c31 N72-21895

**SPACECRAFT REENTRY**
Effects of fabrication-induced defects on performance of ablative heat shield materials in simulated space shuttle reentry
[NASA-CR-2010] c33 N72-21954

**SPACECRAFT STABILITY**
Development of rotation law for application to Skylab gyroscopes to avoid gimbal stop encounters
[NASA-CR-126140] c21 N72-21633

**SPACECRAFT STERILIZATION**
Use of gas and liquid filters to sterilize spacecraft
[NASA-CR-126035] c04 N72-21047
Using ethylene oxide as decontaminating agent for planetary quarantine
[NASA-CR-126034] c04 N72-21048
Requirements for effective planetary quarantine and spacecraft sterilization
[NASA-CR-126033] c04 N72-21049

**SPACECRAFT TRACKING**
Orbital and entry tracking accessory mounted on global map to provide range requirements for reentry vehicles to any landing site
[NASA-CASE-LAR-10626-1] c14 N72-21416

**SPATIAL DISTRIBUTION**
Spatial correlation of auroral radio absorption, using riometers
c07 N72-21146

**SPATIAL FILTERING**
Complex spatial filters in coherent optical correlators recorded by Fourier transform method
[NASA-TN-D-6581] c23 N72-21661

**SPECIFIC HEAT**
Adjustment of calculated band structures for calcium by use of low temperature specific heat data
c26 N72-21710
Calculation of one-electron density of state values from low temperature specific heat measurements
c26 N72-21771
Electron phonon coupling constant and bare electron density of states determined from elecctronic specific heat measurements
c26 N72-21772
Specific heats of hexagonal close-packed erbium and thulium alloys measured in low temperature range between 1.3 and 4.2 K
c26 N72-21773
Measurement of low temperature specific heats of fcc Ru-Rh and Rh-Pd alloys
c26 N72-21774
Densities-of-states at Fermi level of Ti-Mo binary bcc alloys studied using low temperature specific heat augmented by magnetic permeability measurements
c26 N72-21775
Volume dependence of electron specific heat for superconducting gallium, aluminum, and thorium, for obtaining volume dependence of electronic density of states
c26 N72-21787

**SPECIFIC IMPULSE**
Calculation of critical fuel mass for coaxial-flow gas-core reactors for specific conditions of operation
[NASA-TM-X-2534] c22 N72-21646
Characteristics of solid propellant rocket engines for delivering high thrust with short impulse duration
[AD-735381] c28 N72-21823

**SPECIFICATIONS**
Computer systems program specifications for modular space station information management system
[NASA-CR-121088] c34 N72-21967

**SPECTRAL ENERGY DISTRIBUTION**
Spectral characteristics of wind driven waves over small areas of water
[RAE-LIB-TRANS-1634] c13 N72-21363

**SPECTRAL THEORY**
Denmark and Finland research on use of orthogonal functions and spectral method to predict weather
[AD-735896] c20 N72-21605

**SPECTROMETERS**
Specifications for magnetic proton spectrometer facility
[LA-4773-PT-1] c14 N72-21436
Centaur sounding rocket Wadsworth spectrograph experimental design for auroral emission spectrophotographic recording
[ESRO-SM-80] c14 N72-21444

**SPECTROPHOTOMETRY**
Study of adsorption kinetics in liquid phase using atomic absorption spectrophotometry
[NASA-TT-F-14263] c14 N72-21425

**SPECTROSCOPIC ANALYSIS**
High energy gamma photon activation and high resolution gamma ray spectrometry for standard and Apollo 12 rock analysis
[AERE-R-6910] c13 N72-21368
Application of ion-neutralization spectroscopy for determining local density of states of solids at solid surface
c14 N72-21747

**SPECTROSCOPY**
Interferometers for use in Fourier spectroscopy capable of transforming one million samples
[NASA-CR-125980] c14 N72-21411
Spectroscopic research in far infrared region
[AD-735945] c23 N72-21667
Application of ion-neutralization spectroscopy for determining local density of states of solids at solid surface
c14 N72-21747

**SPECTRUM ANALYSIS**
Spectrum analysis of internal acoustic gravity waves based on CW Doppler data
[NASA-CR-2033] c13 N72-21365
Analysis of strongest solar ultraviolet emission lines of Mg II, O I, C II, AND C III and atmospheric model development
[NASA-CR-125981] c29 N72-21829

**SPEECH RECOGNITION**
Development of system for near real time automatic recognition of spoken words
[AD-735723] c07 N72-21182
Survey of digital signal processing techniques for speech analysis
[AD-735919] c07 N72-21184
Digital signal processing algorithms useful in speech research
[AD-735921] c07 N72-21185
Design, development, and characteristics of system for speech understanding
[AD-735758] c07 N72-21187
Evaluation of pattern-matching speech bandwidth compression techniques used with voice data processor system
[AD-735308] c07 N72-21189

**SPHERES**
Plastic sphere for radar tracking and calibration
[NASA-CASE-XLA-11154] c07 N72-21117
Analysis of microasperity elastohydrodynamic lubrication of ball spinning in nonconforming groove and comparison with conventional conditions
[NASA-TN-D-6761] c15 N72-21469

**SPHERICAL SHELLS**
Reflection from radially inhomogeneous spherical shells
[AD-736630] c23 N72-21674

**SPIN**
Subroutines for calculation of spin matrix elements of antiproton-neutron annihilation using Zemach relativistic method
[NOTA-INTERNA-328] c24 N72-21683

**SPIN-ORBIT INTERACTIONS**
Measurement of electroreflectance spectra of semiconductor materials for identification of energy multiplets and spin-orbit splittings
c26 N72-21753

**SPORES**
Lyophilized spore dispenser for production of finely divided monoparticulate cloud of bacterial spores
[NASA-CASE-LAR-10544-1] c15 N72-21477

**STABILITY**
Betatron mode signals in intersecting storage rings and estimates of instability thresholds and growth rates
[CERN-71-15] c24 N72-21681

**STABILIZERS [FLUID DYNAMICS]**
Dual fuselage aircraft design with yawable wing and horizontal stabilizer
[NASA-CASE-ARC-10470-1] c02 N72-21010

**STAINLESS STEELS**
Ultrasonic scanning system for in-place inspection of brazed steel tube joints
[NASA-CASE-MFS-20767] c15 N72-21482
Analysis of chemical reactions and electrical exchanges causing pits in stainless steels exposed to an oxidizing chloride medium
[AEC-TR-7289] c17 N72-21543

**STANDARDIZATION**
Standardization of test procedures for determining stress corrosion cracking in high strength alloys and steels under various environments - conference
[AGARD-CP-98] c32 N72-21900
Standardization of test methods for stress corrosion in metals
c14 N72-21902

**STANDARDS**
Requirements for effective planetary quarantine and spacecraft sterilization
[NASA-CR-126033] c04 N72-21049
High energy gamma photon activation and high resolution gamma ray spectrometry for standard and Apollo 12 rock analysis
[AERE-R-6910] c13 N72-21368
Application of linear elastic fracture mechanics to developing stress corrosion cracking test standards
[NASA-TM-X-68303] c14 N72-21905

**STATIONARY ORBITS**
Solar proton radiation damage of solar cells at synchronous altitudes
c03 N72-21847

**STATISTICAL ANALYSIS**
Compilation of US general aviation accidents for 1969 in which impairment of judgement and efficiency by alcohol was involved
[PB-204991] c02 N72-21023
Design and implementation of computer program for statistical analysis of biological assays and related quantal data
[AD-735145] c08 N72-21233
Classification modes for multidisciplinary, high data rate requirements of ERTS satellites
[NASA-CR-126024] c13 N72-21358
Statistical analysis of temperature regime in Tashkent during Jan. and Feb. 1949 to 1964 for weather forecasting
[NLL-M-22065-[5828.4F]] c20 N72-21582
Machine classification of synoptic processes and meteorological parameters for weather forecasting
[NLL-M-22039-[5828.4F]] c20 N72-21585
Computer simulation and statistical analysis of cloud cover and cloud base height
[AD-735213] c20 N72-21601
Statistical analysis of lunar craters to determine relative age of maria
[NASA-TT-F-14178] c30 N72-21868
Statistical analyses of lunar rock distribution based on Lunokhod 1 data
[NASA-TT-F-14180] c30 N72-21869

**STATISTICAL CORRELATION**
Optical sensing of supersonic flows by correlating deflections in laser beams through flow
[NASA-CASE-MFS-20642] c14 N72-21407
Automatic vehicle control using navigation and guidance algorithms based on digital statistical data
[AD-735605] c21 N72-21637

**STATISTICAL DISTRIBUTIONS**
Pseudo-random number generating programs in Assembly language for random values from discrete probability distributions
[AD-735144] c19 N72-21577
1/f noise distribution in semiconductors
[AD-735944] c26 N72-21805

**STATISTICAL MECHANICS**
Statistical mechanical treatment of one-dimensional quantal many body problem noting phase transitions
[NOTA-INTERNA-332] c24 N72-21684

**STATISTICAL WEATHER FORECASTING**
Statistical analysis of temperature regime in Tashkent during Jan. and Feb. 1949 to 1964 for weather forecasting
[NLL-M-22065-[5828.4F]] c20 N72-21582
Machine classification of synoptic processes and meteorological parameters for weather forecasting
[NLL-M-22039-[5828.4F]] c20 N72-21585

**STEADY FLOW**
Steady barotropic flow of ideal fluid
[NLL-M-22062-[5828.4F]] c12 N72-21309

**STEAM TURBINES**
Design for steam Rankine cycle system for undersea applications
[ORNL-TM-2961] c22 N72-21655

**STEELS**
Thermal stability of molybdenum alloy, low alloy steel production and economics, and improving sound metal yield in cast and rolled products
[NLL-M-21286-[5828.4F]] c17 N72-21514
Use and properties of mild steel in Halden boiling water reactor
[HPR-143] c22 N72-21650
Microelectrodes for measuring pH gradients during stress corrosion of aluminum alloys and 1020 steel exposed to potassium chloride
c17 N72-21909
Microstructure and stress corrosion behavior of welded steel joints
c14 N72-21910
Microscopic characteristics of stress corrosion cracking in steel with high yield strength
c32 N72-21925
Influence of thermomechanical treatment on stress corrosion cracking in steel
c17 N72-21930

**STIFFNESS**
Computer program based on finite element method for analysis of stiffened plates under combined in-plane and lateral loads
[AD-735936] c32 N72-21936
Buckling of stiffened and unstiffened cylindrical and conical shells
[AD-736044] c32 N72-21947
**STOCHASTIC PROCESSES**
Steady state analysis of open or closed networks consisting of N nodes interconnected by links over which mass flows
[AD-735348] c10 N72-21279
Convergence of discretization equations in numerical analysis of degenerate partial differential equations of stochastic control theory
[NASA-CR-126037] c19 N72-21568
**STORAGE BATTERIES**
Improved electrolytes and electrodes for rechargeable, nonaqueous lithium batteries
[AD-735269] c03 N72-21036
Passive thermal control for storage battery using heat exchanger
[AD-735736] c03 N72-21037
High energy secondary batteries for pollution-free electric automobiles
[PB-205254] c03 N72-21039
**STORAGE RINGS [PARTICLE ACCELERATORS]**
Characteristics of circular magnet used as bending magnet for high energy storage rings
[BNL-16299] c11 N72-21301
Betatron mode signals in intersecting storage rings and estimates of instability thresholds and growth rates
[CERN-71-15] c24 N72-21681
Electron-positron storage rings noting QED, vector meson, and hadronic experiments
[NOTA-INTERNA-343] c24 N72-21686
**STORAGE TANKS**
Apparatus for aligning shadow shields and cryogenic storage tanks in outer space with the sun
[NASA-CASE-KSC-10622-1] c31 N72-21893
**STRAIN RATE**
Accelerated slow strain rate tensile method
c32 N72-21924
Strain rate experiments to evaluate resistance to stress corrosion cracking
c17 N72-21927
**STRATIFICATION**
Angular deviations of radio waves from horizontal stratification
c07 N72-21139
Properties of discretely stratified microstructure in Arctic Ocean
[AD-734973] c13 N72-21379
**STRESS [PHYSIOLOGY]**
Effects of exposure to blast induced winds and pressure variations on biophysical parameters
[AD-734208] c04 N72-21054
Lactate-pyruvate and redox state responses of blood and tissue in chronic hypercapnia
[AD-734120] c04 N72-21057
**STRESS ANALYSIS**
Nomenclature, stress-strain analysis, and crack propagation in metals
[AD-735700] c17 N72-21550
Development of procedures for determining strength of cast turbine blades under variable load conditions
[JPRS-55555] c28 N72-21818
Stressing systems and environmental methods used by European Federation stress corrosion tests
c14 N72-21904
Smooth beam and precracked specimen testing of stress behavior of aluminum alloys
c17 N72-21920
Influence of grain size on stress-strain relationship of tensile tested metals
[RAE-LIB-TRANS-1585] c32 N72-21934
**STRESS CONCENTRATION**
Computer programs for calculating elastic stress intensity factors of pressure hulls
[AD-735874] c32 N72-21943
**STRESS CORROSION**
Standardization of test procedures for determining stress corrosion cracking in high strength alloys and steels under various environments - conference
[AGARD-CP-98] c32 N72-21900
Stress corrosion cracking in aircraft structures and various materials - historical review
c32 N72-21901
Standardization of test methods for stress corrosion in metals
c14 N72-21902
Stress corrosion tests of 7XXX series high strength aluminium alloys in laboratory environment
c14 N72-21903
Stressing systems and environmental methods used by European Federation stress corrosion tests
c14 N72-21904
Application of linear elastic fracture mechanics to developing stress corrosion cracking test standards
[NASA-TM-X-68303] c14 N72-21905
Determination of stress corrosion cracking parameters for 300M steel
c32 N72-21906
Effects of repassivation and crack velocity on stress corrosion cracking in alloys
c17 N72-21907
Stress corrosion index for measuring conjoint action between stress and corrosion in stress corrosion of Al alloys
c32 N72-21908
Microelectrodes for measuring pH gradients during stress corrosion of aluminum alloys and 1020 steel exposed to potassium chloride
c17 N72-21909
Microstructure and stress corrosion behavior of welded steel joints
c14 N72-21910
Cantilever bending tests for determining susceptibility of high strength alloys to stress corrosion cracking
c14 N72-21911
Stress corrosion tests of titanium alloys and electron beam welded titanium alloys
c32 N72-21912
Threshold stress intensity values and crack propagation rates for stress corrosion of high strength steels in aqueous environment
c32 N72-21913
Laboratory equipment for testing stress corrosion of bolt loaded WOL specimens and monitoring crack growth
c32 N72-21914
Krafft model for determining susceptibility of Zn-Mg-Cu aluminum alloys to stress corrosion crack growth
c32 N72-21915
Precracked cantilever beam and long term beam exposure tests for determining stress corrosion of Al alloys in sea water
c17 N72-21919
Stress corrosion in two aluminum alloys
c14 N72-21921
Stress corrosion behavior of die forgings made from Al-Zn-Mg-Cu alloys
c32 N72-21922
Effects of heat treatment, size, specimen type, and test environment on two precipitation-hardened stainless steels during stress corrosion cracking tests
c17 N72-21923
Microscopic characteristics of stress corrosion cracking in steel with high yield strength
c32 N72-21925
Hot salt stress corrosion cracking of titanium alloys used as radiative heat shields in space shuttles
[NASA-TM-X-68304] c17 N72-21926
Strain rate experiments to evaluate resistance to stress corrosion cracking
c17 N72-21927
Techniques for studying crack morphology, contaminants, and electrochemistry in stress corrosion
c32 N72-21928
Influence of thermomechanical treatment on stress corrosion cracking in steel
c17 N72-21930
Mechanical properties and stress corrosion of hot rolled alloy plates
c32 N72-21931
**STRESS MEASUREMENT**
Stress corrosion index for measuring conjoint action between stress and corrosion in stress corrosion of Al alloys
c32 N72-21908
**STRESS-STRAIN DIAGRAMS**
Room temperature tensile and compressive stress-strain diagrams for high strength steels
[AD-735314] c17 N72-21552
Stress-strain relation in solid rocket propellant by ignition
[ICT-10/70] c27 N72-21810
**STRESSES**
Long term strength of anisotropic composite materials under plane stress
[AD-735434] c18 N72-21560
Behavior of ATJ-S graphite under multiaxial stress states
[AD-736470] c18 N72-21565
**STRONTIUM COMPOUNDS**
Compatibility of strontium compounds with superalloys at 900 and 1100 C
[ORNL-4625] c17 N72-21541
**STRUCTURAL FAILURE**
Stress corrosion cracking in aircraft structures and various materials - historical review
c32 N72-21901
**STRUCTURAL STABILITY**
Structural stability analysis of elastic plates with finite element method based on expanded variational principles
c32 N72-21935
**STRUCTURAL STRAIN**
Nomenclature, stress-strain analysis, and crack propagation in metals
[AD-735700] c17 N72-21550
Influence of grain size on stress-strain relationship of tensile tested metals
[RAE-LIB-TRANS-1585] c32 N72-21934
**STRUCTURAL VIBRATION**
Application of mean square approximation system for determining structural vibrations and frequency variability
[NASA-CR-1961] c32 N72-21933
**STYRENES**
Studying kinetics of degradation of polystyrenes and copolymers by dynamic thermogravimetry in vacuum
[AD-735278] c18 N72-21561
**SUBMERGED BODIES**
Matrix element of solid state ultrasonic image converter using light emitting diode in nonscanning display for acoustic imaging of underwater objects
[AD-736535] c09 N72-21272
**SUBROUTINES**
MIMUSA, matrix iteration method of unfolding spectra, using FORTRAN 4 subroutine
[RD/B/N-1962-PT-1] c08 N72-21228
Subroutines for calculation of spin matrix elements of antiproton-neutron annihilation using Zemach relativistic method
[NOTA-INTERNA-328] c24 N72-21683
**SUCTION**
Computer program and numerical analysis of feasibility of using suction between and along runways to remove trailing edge vortex streets
[IDA-LOG-HQ-69-10164] c11 N72-21290
**SULFIDES**
Synthesis of thin silver sulfide films and measurement of electrical properties when used as cathode in solid electrolyte electrical cell
[NASA-TT-F-14196] c03 N72-21035
**SULFUR COMPOUNDS**
Application of aerial photography for detecting effects of air pollution from sulfur dioxide on stands of timber
[PB-205279] c14 N72-21458
**SULFUR OXIDES**
Coulometric measurement of micro-impurities of nitrogen oxide, sulfur dioxide, and ammonia in gases
[NLL-M-22138-[5828.4F]] c14 N72-21404
**SUNSPOT CYCLE**
Planetary resonance structure, sunspot activity, and bistable modes of solar oscillation
[NASA-CR-2035] c30 N72-21870
**SUPERCONDUCTIVITY**
Tunneling measurements of superconduction quasiparticle density of states of metals and semiconductors, and calculation of phonon spectra
c26 N72-21781
Fermi surface topology information on indium cadmium alloy system from superconductivity measurements
c26 N72-21788
**SUPERCONDUCTORS**
Mechanically stable, thermally cyclicable point contacts for use in superconducting devices
[AD-735501] c14 N72-21453
Density of states from superconducting critical field measurements in indium and thallium
c26 N72-21782
Volume dependence of electron specific heat for superconducting gallium, aluminum, and thorium, for obtaining volume dependence of electronic density of states
c26 N72-21787
Density of states model applied to superconductivity problem in high transition temperature beta-tungsten superconductors
[NASA-CR-126047] c26 N72-21793
Electric and electromagnetic shielding with superconductors
[AD-735396] c26 N72-21806
**SUPERFLUIDITY**
Attenuation coefficient of third sound in liquid He film and stability of quantized persistent calculations of thin helium film in Landau region
[AD-735924] c33 N72-21964
**SUPERHIGH FREQUENCIES**
Variable frequency microwave spacecraft antenna
[NASA-CASE-NPO-11264] c07 N72-21155
**SUPERPOSITION [MATHEMATICS]**
Superposition principle for nonclassical forced motion of stationary and rotating beams with tip masses
[AD-735683] c32 N72-21939
**SUPERSONIC AIRCRAFT**
Design problems of inlets and nozzles used in supersonic and V/STOL propulsion systems
[NASA-TM-X-67741] c28 N72-21819
**SUPERSONIC BOUNDARY LAYERS**
Experimental pitot probe displacement measurements in supersonic turbulent boundary layer
[NASA-TN-D-6759] c12 N72-21313
**SUPERSONIC COMBUSTION**
Triethyl aluminum as fuel or fuel additive for heat addition by external combustion hypersonic vehicle
[DLR-MITT-71-26] c28 N72-21822
**SUPERSONIC FLOW**
Power series solutions for supersonic flow in ideal dissociating gas
[AD-735697] c12 N72-21323
Optical sensing of supersonic flows by correlating deflections in laser beams through flow
[NASA-CASE-MFS-20642] c14 N72-21407

**SUPERSONIC NOZZLES**
Determining suitability of supersonic jets for proton beam neutralizer
[UCRL-51089] c12 N72-21318

**SUPERSONIC SPEEDS**
Aerodynamic characteristics of low aspect ratio, cruciform wing missile model with all-moveable wings and tails at supersonic speed
[NASA-TM-X-2531] c01 N72-20971
Wind tunnel tests of M2-F2 lifting body entry configuration at transonic and supersonic speeds and selected Reynolds numbers
[NASA-TM-X-2511] c02 N72-21005

**SUPPORTS**
Pointing capability of isolation and control system of Apollo type telescope mount
[NASA-TN-D-6676] c30 N72-21863

**SURFACE ENERGY**
Methods of calculating surface energy, potential, and charge density near interface of transition metal
[NASA-CR-126043] c26 N72-21748

**SURFACE NAVIGATION**
Automatic vehicle control using navigation and guidance algorithms based on digital statistical data
[AD-735605] c21 N72-21637

**SURFACE PROPERTIES**
Determination of density of states by analyzing current-voltage characteristics in field emission resonance tunneling in junctions
c26 N72-21749

**SURFACE REACTIONS**
Processes, surfacer reactions, and mixing theory of adhesion
[NLL-RTS-6925] c06 N72-21093

**SURFACE TEMPERATURE**
Thermal parameters for predicting precipitation type for Loring AFB, Maine
[AD-735724] c20 N72-21616

**SURVEILLANCE**
Utilization of militarized computers for target acquisition and surveillance signal processing applications
[AD-735327] c08 N72-21242

**SWEEP FREQUENCY**
Sweep frequency backscatter radars as detectors of high latitude ionospheric phenomena
c07 N72-21147

**SWEPT WINGS**
Nonequilibrium boundary layer flow at leading edge of highly swept hypersonic infinite span wing
[PB-204710] c01 N72-20975

**SWIRLING**
Effect of swirl on conical diffuser performance and separation phenomena
[AD-735383] c12 N72-21321

**SWITCHING CIRCUITS**
Switching type voltage regulator with relatively simple circuit arrangement
[NASA-CASE-LEW-11005-1] c09 N72-21243

**SYMBOLS**
Lists of data users, acronyms, and abbreviations in TACC data base
[AD-735731] c08 N72-21237

**SYNCHRONIZED OSCILLATORS**
Automatic frequency control device for providing frequency reference for voltage controlled oscillator
[NASA-CASE-KSC-10393] c09 N72-21247

**SYNOPTIC METEOROLOGY**
Machine classification of synoptic processes and meteorological parameters for weather forecasting
[NLL-M-22039-[5828.4F]] c20 N72-21585
Assimilation of 4-dimensional meteorological data in objective forecasting model
[NLL-M-22063-[5828.4F]] c20 N72-21587
Synoptic meteorological data tables of Indias coastal marine areas
[AD-735441] c20 N72-21594
Synoptic models for studying summer monsoon and diurnal variations of meteorological parameters over Korat Plateau, Thailand
[AD-735283] c20 N72-21600

**SYSTEM EFFECTIVENESS**
Effectiveness of system for towing deep submerged hydrophone array
[AD-735885] c23 N72-21671

**SYSTEM FAILURES**
Fault isolation capabilities for general purpose digital computer used in guidance and control applications
c08 N72-21220

**SYSTEMS ANALYSIS**
Task, I/O, and configuration management of shuttle flight executive system
[NASA-CR-115514] c08 N72-21205
Aerospace computer memory technology and application of particular techniques to various system requirements
c08 N72-21218
Analysis of tasks required for data processing equipment in advanced aircraft navigation systems
c21 N72-21222
System capacity, station capacity, urban grid design, and headway requirements for personalized rapid transit systems
[PB-204801] c34 N72-21977

**SYSTEMS ENGINEERING**
Conceptual design of 20-ton wheeled air cushion lighter to transport cargo from ships to shore and inland
[AD-735667] c02 N72-21012
Evaluation program for frequency separated display principle in aircraft instrument panels
[AD-735915] c02 N72-21027
Application of systems engineering concept to US Coast Guard aviator training programs
[AD-735051] c05 N72-21080
Development of system for near real time automatic recognition of spoken words
[AD-735723] c07 N72-21182
Design, development, and characteristics of system for speech understanding
[AD-735758] c07 N72-21187
Advantages and disadvantages of federated and integrated computer system organizations for utilization in current aerospace systems
c08 N72-21213
Tests to determine design feasibility of unsurfaced soil facilities for operations of C-5A aircraft
[AD-735344] c13 N72-21398
Radiation measuring instruments designed for civil defense use
[ORNL-TM-3370] c14 N72-21438
Method and apparatus for providing active attitude control for spacecraft by converting any attitude motion of vehicle into simple rotational motion
[NASA-CASE-HQN-10439] c21 N72-21624
Specification for performance, design, fabrication, test and quality assurance for electrothermal hydrazine thrustor
[NASA-CR-122377] c28 N72-21820


## T


**T-33 AIRCRAFT**
Development of direct side force control on aircraft during flight and application to improved bombing accuracy
[AD-735294] c02 N72-21030

**TABLES [DATA]**
Tabulation of geomagnetic data recorded by Spanish geophysical observatories in 1968
c13 N72-21372
Synoptic meteorological data tables of Indias coastal marine areas
[AD-735441] c20 N72-21594
Meteorological data tables for launching Lance missiles
[AD-735361] c20 N72-21595
Meteorological data tables for launching 12804 Lance missile number 2120 round number 137
[AD-735359] c20 N72-21607
Meteorological data tables for launching 11604 Lance missile number 5129 round number 138 RMT
[AD-735360] c20 N72-21608
Meteorological data tables predicted by macro-scale baroclinic prediction model
[AD-735737] c20 N72-21610
Meteorological data tables from 1000 mb macro-scale model predictions
[AD-735740] c20 N72-21611
Meteorological data tables from macro-scale cloud model predictions
[AD-735739] c20 N72-21612
Weather forecast tables as predicted by limited area mesoscale prediction model
[AD-735738] c20 N72-21613
Meteorological data tables for launching 12806 Lance missile number 2112 round 135
[AD-735358] c20 N72-21617
Meteorological data tables for launching 11601 Lance missile number 2171 round 132
[AD-735356] c20 N72-21619
Meteorological data tables for launching 12802 Lance missile number 2132 round 133
[AD-735355] c20 N72-21620
Meteorological data tables for launching Honest John missile number 354, round number 613 RML
[AD-735354] c20 N72-21621
Tables on structure and magnitude of loran-C propagation anomaly caused by 100 kHz pulse on isolated terrain
[AD-735680] c21 N72-21638
Tabulated uncorrected and barometer-corrected cosmic ray neutron monitor data
[AECL-4060] c29 N72-21849

**TACAN**
Digital computers for navigation and guidance systems and fire control systems in tactical aircraft
c08 N72-21227

**TANKS [CONTAINERS]**
Application of finite difference and finite element methods for analyzing symmetric fluid oscillations
[DLR-FB-71-69] c12 N72-21316

**TAPE RECORDERS**
Design and characteristics of recording system for selective reprocessing and filtering of data to obtain optimum signal to noise ratios
[NASA-CASE-ERC-10112] c07 N72-21119

**TARGET ACQUISITION**
Utilization of militarized computers for target acquisition and surveillance signal processing applications
[AD-735327] c08 N72-21242

**TASK COMPLEXITY**
Automated instructional monitors for diagnosing student difficulties in acquiring complex concepts and skills
[AD-736212] c05 N72-21090

**TAYLOR INSTABILITY**
Using two-dimensional Lagrangian code to computer growth of perturbed interface between perfect gas and aluminum
[LA-4754] c12 N72-21319

**TECHNOLOGY ASSESSMENT**
Assessment of aircraft emission control technology and feasibility analysis of various control methods
[PB-204878] c02 N72-21017

**TECHNOLOGY TRANSFER**
Review of literature dealing with communication satellite technology with emphasis on educational aspects
[NASA-CR-125933] c34 N72-21968

**TECHNOLOGY UTILIZATION**
Technological improvements for reducing costs of solar cells and solar arrays
[NASA-TM-X-68035] c03 N72-21033
Collection of digital circuits with direct application in computer oriented systems
[NASA-SP-5949[01]] c08 N72-21209
Announcing aerospace developments in seals and sealing techniques for technology utilization in other industries
[NASA-SP-5905[03]] c15 N72-21480

**TELECOMMUNICATION**
Capability of navigation satellite system for predicting ionospheric conditions for optimum transmitting parameters in high frequency sky wave telecommunication
[AD-735866] c07 N72-21174
Scientific research in theoretical plasma, and solid state physics and communication and microwave transmission
[AD-735366] c23 N72-21673

**TELEMETRY**
Tests of remote automatic multipurpose station early warning system telemetry transmissions
[AD-736221] c07 N72-21195
Project coordination and mission support for spacecraft operations noting data acquisition and transmission - conferences
[ESRO-SP-64] c11 N72-21291
Arctic research including studies of ice albedo, acoustic telemetry, and ice pack support vehicle
[AD-735957] c13 N72-21383

**TELESCOPES**
Low light image recording system for recording data from optical telescopes
[AD-735830] c23 N72-21669
Pointing capability of isolation and control system of Apollo type telescope mount
[NASA-TN-D-6676] c30 N72-21863

**TELEVISION EQUIPMENT**
Effect of background photon flux density on performance of infrared vidicons and infrared scanning systems
[AD-735324] c07 N72-21186
Design and development of data gathering and reduction system for simulating flight path of guided missile
[AD-736150] c07 N72-21196

**TELLURIC CURRENTS**
Electrical conductivity of earth crust and upper mantle, and magnetotelluric field theory
c13 N72-21348

**TEMPERATURE COMPENSATION**
Temperature compensated light source with light emitting diode and circuitry for maintaining luminous power independent of temperature changes
[NASA-CASE-ARC-10467-1] c09 N72-21249

**TEMPERATURE CONTROL**
Passive thermal control for storage battery using heat exchanger
[AD-735736] c03 N72-21037
Optimization of fluidic temperature control for space suits based on flow visualization
[NASA-CR-115511] c14 N72-21426
Atomic hydrogen maser with automatic bulb temperature control to eliminate frequency shift due to collision of hydrogen atoms with storage bulb walls
[NASA-CASE-HQN-10654-1] c16 N72-21502

**TEMPERATURE EFFECTS**
Mechanism by which inert gases influence metabolism
[NASA-CR-62079] c04 N72-21041
Determination of effects of shock heating of radome on radar range of ground station
c07 N72-21158
Temperature dependences of transport phenomena and electronic density of states at high temperatures for transition metals
c26 N72-21783

Development of sensors for detecting amount of ablation over ablating surfaces and change in boundary layer flow conditions
[NASA-CASE-LAR-10439-1] c33 N72-21956

**TEMPERATURE GRADIENTS**
Temperature compensated light source with light emitting diode and circuitry for maintaining luminous power independent of temperature changes
[NASA-CASE-ARC-10467-1] c09 N72-21249
Anomalies in North Atlantic Ocean temperature and ocean-atmosphere temperature differences preceding and during severe 1968-1969 winter
[NLL-M-22215-[5828.4F]] c20 N72-21583

**TEMPERATURE MEASUREMENT**
Assessment of human skin temperature rise suppression by edge losses during thermal irradiation
[AD-735881] c04 N72-21069
Design, development, and evaluation of bimetallic temperature probe for measuring temperature of soil
[NASA-TT-F-14226] c14 N72-21413
Temperature measurement system of radiometer type
[NASA-CASE-MFS-20781] c14 N72-21429

**TEMPERATURE PROBES**
Design, development, and evaluation of bimetallic temperature probe for measuring temperature of soil
[NASA-TT-F-14226] c14 N72-21413

**TEMPERATURE PROFILES**
Measurement of wind and temperature profiles and turbulent fluctuations in wind velocity under homogeneous turbulence
[AD-735393] c20 N72-21603

**TENSILE PROPERTIES**
Heat treatment of hydrolytically degraded polyimide film and regeneration of tensile properties
[RM-538] c06 N72-21104
Room temperature tensile and compressive stress-strain diagrams for high strength steels
[AD-735314] c17 N72-21552

**TENSILE STRESS**
Accelerated slow strain rate tensile method
c32 N72-21924

**TERMINAL FACILITIES**
Development of active and passive techniques for detecting and measuring presence and intensity of wingtip vortices generated in airport areas
[DOT-TSC-FAA-72-13] c02 N72-20999
Bibliography of reports and simulation models describing air traffic control procedures for all phases of aircraft operation
[DOT-TSC-FAA-71-7] c21 N72-21626
Development of discrete address beacon system to improve operation of microwave landing system for high density terminal area surveillance
[DOT-TSC-FAA-71-26] c21 N72-21628
Development of model of airport airside system to simulate aircraft operations and controller functions in terminal area
[PB-204802] c21 N72-21634

**TERMINAL GUIDANCE**
Terminal guidance system for guiding aircraft into preselected altitude and/or heading at terminal point
[NASA-CASE-FRC-10049-1] c21 N72-21632
Adaptive control autopilot for identifying tactical missile
[AD-735488] c31 N72-21899

**TERRAIN ANALYSIS**
Infrared radiance from geological materials and system for airborne use over terrain with little vegetation
[NASA-CR-115524] c13 N72-21356

**TEST EQUIPMENT**
Application of self-balancing bridge for determining electrothermal and nonlinear behavior of electroexplosive device
[NASA-CR-125931] c11 N72-21281
Test equipment to prevent buckling of small diameter specimens during compression tests
[NASA-CASE-LAR-10440-1] c14 N72-21420
Evaluation of static-pressure measuring probes used in wind tunnel tests at supersonic and hypersonic speeds
[AD-736017] c14 N72-21461
Remote handling device for mixing or analyzing dangerous chemicals
[NASA-CASE-LAR-10634-1] c15 N72-21476
Apparatus and method for quantitatively determining performance of linear explosives, mild detonating fuze, and flexible linear shaped charges
[NASA-CASE-LAR-10800-1] c33 N72-21955

**TEST FACILITIES**
Development of techniques and equipment for determining moment of inertia of aircraft as applied to A-37 and P-1127 aircraft
[FTC-TIM-71-1001] c02 N72-21007
Analysis of Langley Research Center activities, geography, geology, and climate to determine sources of environmental pollution
[NASA-TM-X-67680] c11 N72-21285
Analysis of NASA-Ames Research Center activities, geography, geology, and climate to determine sources of environmental pollution
[NASA-TM-X-67669] c11 N72-21286
Characteristics of digital computer control and abort system for controlling test operations of rocket engines, structure tests, and wind tunnel tests
[NASA-TM-X-68040] c11 N72-21287
Stress corrosion tests of 7XXX series high strength aluminium alloys in laboratory environment
c14 N72-21903

**TEST RANGES**
Wind velocity profiles measured by smoke trail technique at Eastern Test Range during 1964
[NASA-TN-D-6746] c20 N72-21589

**TEXAS**
Reference file for aiding weather forecasts at Loredo AFB, Texas
[AD-735791] c20 N72-21615

**THAILAND**
Synoptic models for studying summer monsoon and diurnal variations of meteorological parameters over Korat Plateau, Thailand
[AD-735283] c20 N72-21600

**THALLIUM**
Density of states from superconducting critical field measuremnts in indium and thallium
c26 N72-21782

**THEOREM PROVING**
Polynomials orthogonal to holomorphic functions of many complex variables and analog of Riesz-Fischer theorem
[NLL-M-22038-[5828.4F]] c19 N72-21566

**THEORETICAL PHYSICS**
Scientific research in theoretical plasma, and solid state physics and communication and microwave transmission
[AD-735366] c23 N72-21673

**THERMAL CONDUCTIVITY**
Thermally conductive polymer for potting electrical components
[NASA-CASE-GSC-11304-1] c06 N72-21105
Elastic wave velocity and attenuation, gamma ray absorption, and thermal conductivity in rocks of interest to seismologists
c13 N72-21340
Heat conductivity of argon in shock tubes at 5000 K
[NLL-M-22129-[5828.4F]] c33 N72-21950
Thermoelastic stress conditions and heat conductivity of plates and bodies of revolution
[AD-735582] c33 N72-21961

**THERMAL CONTROL COATINGS**
Measurement of solar absorption and thermal emittance properties of selected thermal control coatings exposed to exhaust of thruster engine
[NASA-TM-X-68044] c33 N72-21952

**THERMAL CYCLING TESTS**
Life tests for SNAP 23A fueled prototype mockup system
[WANL-4219-1] c22 N72-21656

**THERMAL DIFFUSION**
Methods of carbon isotope separation, thermal diffusion, and low temperature studies
[MLM-1828] c06 N72-21109

**THERMAL EMISSION**
Measurement of solar absorption and thermal emittance properties of selected thermal control coatings exposed to exhaust of thruster engine
[NASA-TM-X-68044] c33 N72-21952

**THERMAL ENERGY**
Analysis of photoabsorption and thermal processes occurring in polar thermosphere through deposition or loss of thermal energy or modification of composition
[AD-735305] c13 N72-21400

**THERMAL EXPANSION**
Thermal expansion coefficient of activated vacancy in Zn and Cd
[RPI-3820-5] c17 N72-21545

**THERMAL NOISE**
Role of solids thermal microwave noise in earth resources microwave radiometry
[RAC-0-3-R16] c07 N72-21163

**THERMAL PROTECTION**
Hot salt stress corrosion cracking of titanium alloys used as radiative heat shields in space shuttles
[NASA-TM-X-68304] c17 N72-21926

**THERMAL RADIATION**
Assessment of human skin temperature rise suppression by edge losses during thermal irradiation
[AD-735881] c04 N72-21069

**THERMAL REACTORS**
Power control system for thermal nuclear reactor
[NASA-CASE-XLE-05799] c22 N72-21644

**THERMAL STABILITY**
Analysis of mirror wave front distortions caused by Gaussian distributed laser radiation
[AD-735282] c23 N72-21668
Trace amounts of fuel-soluble metal compounds affecting thermal stability of JP-7 fuel
[AD-736475] c27 N72-21813

**THERMISTORS**
Application of thermistor mass flow rate sensor to aircraft meteorological instruments
[AD-736152] c20 N72-21622

**THERMODYNAMIC PROPERTIES**
Redox equilibria, thermodynamic properties of aqueous systems, and electrochemistry of aqueous systems and molten salts
[STU-68-261-U-208] c17 N72-21542
Thermodynamic properties of tungsten, niobium, and molybdenum
[AD-736039] c17 N72-21553
Density of states curves used to obtain thermodynamic information associated with allotropic phase transitions in bcc and fcc iron
c26 N72-21790
Numerical analysis of vaporization time of drops in film boiling with consideration of diffusive and radiative effects
[NASA-TM-X-68037] c33 N72-21953

**THERMODYNAMICS**
Nonisothermal constitutive equations and thermodynamics for class of simple fluids with fading memory
[AD-735928] c06 N72-21114
Thermodynamic and solid solution studies of nonferrous metallic compounds
[JPRS-55392] c17 N72-21517
Thermodynamics of capillary porous body/liquid system involving graphite, water, and chlorides
c18 N72-21519
Thermomechanical processing to develop various microstructures in nickel and nickel alloys
[NASA-CR-2025] c17 N72-21534

**THERMOELECTRIC POWER GENERATION**
Reference design for thermoelectric isotope power unit using potassium heat pipes
[ORNL-TM-2959] c33 N72-21958

**THERMOGRAVIMETRY**
Studying kinetics of degradation of polystyrenes and copolymers by dynamic thermogravimetry in vacuum
[AD-735278] c18 N72-21561
Thermogravimetric analysis of thermal degradation of epoxide resins
[AD-735687] c18 N72-21564

**THERMOLUMINESCENCE**
Method for detecting oxygen in gas by thermoluminescence
[NASA-CASE-LAR-10668-1] c06 N72-21103

**THERMOMETERS**
Digital thermometer with interchangeable temperature sensors
[AD-735662] c05 N72-21087

**THERMOPHYSICAL PROPERTIES**
Thermophysical properties of liquid metals
[AD-735467] c17 N72-21547

**THERMOSETTING RESINS**
Apparatus and method for compression molding of thermosetting plastics
[NASA-CASE-LAR-10489-1] c15 N72-21484
Process for molding long thin-wall tubular bodies from thermosetting plastic molding compounds
[NASA-CASE-LAR-10782-1] c15 N72-21487

**THERMOSPHERE**
Analysis of photoabsorption and thermal processes occurring in polar thermosphere through deposition or loss of thermal energy or modification of composition
[AD-735305] c13 N72-21400

**THETA PINCH**
Alternating direction implicit finite difference method for studying theta pinch dynamics and plasma control
[UCRL-51103] c25 N72-21695

**THIN FILMS**
Synthesis of thin silver sulfide films and measurement of electrical properties when used as cathode in solid electrolyte electrical cell
[NASA-TT-F-14196] c03 N72-21035
Measurement of photoemission from thin films of europium and barium excited by vacuum ultraviolet and soft X ray radiation
c26 N72-21728

**THIN WALLED SHELLS**
Laboratory equipment for testing welded seams of thin walled shells
[AD-735925] c32 N72-21945

**THOMSON SCATTERING**
Electron density distribution and electron temperature measurements of F region by Millstone Hill Thomson scatter radar system during 1967
[AD-735727] c13 N72-21387

**THORIUM ISOTOPES**
Geochemical studies using Th and U isotopes as geological indices in marine environments
[ORO-3622-12-PT-1] c13 N72-21366

**THREE DIMENSIONAL FLOW**
Numerical conversion of three dimensional stationary detached flow to two dimensional nonstationary detached flow about flat bodies
[AD-735604] c12 N72-21322

**THRUST CONTROL**
Design, development, and qualification of Apollo lunar module reaction control system
[NASA-TN-D-6740] c31 N72-21887

**THRUST LOADS**
First-order thrust load analysis of arched-outer-race ball bearing with consideration of centrifugal forces
[NASA-TN-D-6765] c15 N72-21470

**THRUST TERMINATION**
Performance test to determine effectiveness of third stage destruct system on Athena rocket vehicle propulsion system
[AD-735289] c28 N72-21826

THULIUM
Energy level calculation for ionized thulium using total angular momentum states of 4f12 configuration
[AD-735319] c06 N72-21112
Specific heats of hexagonal close-packed erbium and thulium alloys measured in low temperature range between 1.3 and 4.2 K
c26 N72-21773

TIDES
Earth tide observation stations in Czechoslovakian mines equipped with pendulums and inclinometers
c13 N72-21330

TILTING ROTORS
Blade stress analysis, wind tunnel models, and test procedures for investigating conversion process of folding tilt-rotor aircraft - Vol. 4
[AD-735733] c02 N72-21028

TIME LAG
Optimal control problems with lags
[AD-735475] c19 N72-21572

TIROS OPERATIONAL SATELLITE SYSTEM
Potential cost reductions in operational ITOS weather satellite program by shuttle/tug availability
[NASA-CR-122398] c31 N72-21895

TITANIUM
Effect of titanium concentration on structure and temperature of brittle-ductile transition in alloys of Cr-Ti-V-B system
c17 N72-21522
Structure of d-band for Sc, Ti and Zr in 4 to 11.6 eV range by photoemission spectroscopy
c26 N72-21726

TITANIUM ALLOYS
Effect of titanium concentration on structure and temperature of brittle-ductile transition in alloys of Cr-Ti-V-B system
c17 N72-21522
Densities-of-states at Fermi level of Ti-Mo binary bcc alloys studied using low temperature specific heat augmented by magnetic permeability measurements
c26 N72-21775
Stress corrosion tests of titanium alloys and electron beam welded titanium alloys
c32 N72-21912
Hot salt stress corrosion cracking of titanium alloys used as radiative heat shields in space shuttles
[NASA-TM-X-68304] c17 N72-21926
Failure of welded joints in Ti-Al-Sn alpha type alloys in CCl4 vapor
c32 N72-21929

TITANIUM BORIDES
Interaction and marginal wetting angles of chromium and titanium borides with iron and nickel
c17 N72-21518

TITANIUM COMPOUNDS
Application of soft X ray spectroscopy for determining electronic properties of titanium interstitial and intermetallic compounds
c26 N72-21743

TOPOGRAPHY
Bathymetric chart of Carmel Bay
[AD-734986] c13 N72-21380

TORPEDOES
Torpedo drag reduction, using MHD boundary layer control and assuming nonzero electric field
[AD-735471] c12 N72-21320

TOUCH
Mechanically operated hand which can depress trigger using touch control device
[NASA-CASE-MFS-20413] c15 N72-21463

TOWED BODIES
Effectiveness of system for towing deep submerged hydrophone array
[AD-735885] c23 N72-21671

TOXICITY AND SAFETY HAZARD
Remote handling device for mixing or analyzing dangerous chemicals
[NASA-CASE-LAR-10634-1] c15 N72-21476

TRACE CONTAMINANTS
Trace amounts of fuel-soluble metal compounds affecting thermal stability of JP-7 fuel
[AD-736475] c27 N72-21813

TRAFFIC CONTROL
Automatic data reduction aerial photographs of highway traffic
[PB-204810] c14 N72-21450

TRAJECTORY ANALYSIS
Design and development of data gathering and reduction system for simulating flight path of guided missile
[AD-736150] c07 N72-21196

TRAJECTORY OPTIMIZATION
Programmers manual for generalized digital computer program written in FORTRAN for simulation and/or optimization of arbitrarily defined vehicle flight paths
[AD-735293] c08 N72-21239

TRANSDUCERS
Intruder detection system with signal transmission in response to transducer
[NASA-CASE-ARC-10097-2] c07 N72-21161
Carrier-type transducer with carrier modulation
[NASA-CASE-NUC-10107-1] c09 N72-21254
Transducer and frequency discriminator circuit with four-terminal circulating diode bridge
[NASA-CASE-ARC-10364-1] c10 N72-21276
Finite element mathematical models for equations of motion of flexing head of BQS-6 transducer
[AD-735459] c16 N72-21505

TRANSFER OF TRAINING
Automated instructional monitors for diagnosing student difficulties in acquiring complex concepts and skills
[AD-736212] c05 N72-21090

TRANSIENT RESPONSE
Transient response analysis of single phase bridge rectifier circuit
[RAE-LIB-TRANS-1620] c10 N72-21273
Computer program for analysis of transient afterheat temperature and pressure response of gas cooled nuclear reactor
[NASA-CR-120825] c22 N72-21647

TRANSITION
Numerical analysis of density conditions necessary for production of phase transition in solids
c26 N72-21750

TRANSITION FLOW
Computer program for solving compressible nonsimilar boundary layer equations for laminar, transitional, or turbulent flows of perfect gas
[NASA-TM-X-2458] c12 N72-21312

TRANSITION METALS
Effects of high transition elements on hardness of Mo alloys
[NASA-TM-X-68028] c17 N72-21525
Electron density of states for noble and transition metals by X ray photoelectron spectroscopy
c26 N72-21722
Soft X ray spectroscopic method for recording L series valence band spectra in iron, cobalt, nickel, copper, and zinc
[NASA-CR-126042] c26 N72-21742
Methods of calculating surface energy, potential, and charge density near interface of transition metal
[NASA-CR-126043] c26 N72-21748
Electron phonon coupling constant and bare electron density of states determined from elecctronic specific heat measurements
c26 N72-21772
Knight shifts and temperature dependence in electron density of states of transition metals
c26 N72-21776
Temperature dependences of transport phenomena and electronic density of states at high temperatures for transition metals
c26 N72-21783

TRANSITION POINTS
Measurement of absorption structure of lithium, beryllium, sodium, magnesium, and aluminum by photoabsorption process
c26 N72-21735

TRANSITION TEMPERATURE
Density of states model applied to superconductivity problem in high transition temperature beta-tungsten superconductors
[NASA-CR-126047] c26 N72-21793

TRANSLATIONAL MOTION
Positioning mechanism for converting translatory motion into rotary motion
[NASA-CASE-NPO-10679] c15 N72-21462

TRANSMITTANCE
Atmospheric transmittance near 5 microns and transmittance of CO laser radiation through synthetic atmospheres
[AD-736037] c16 N72-21512

TRANSMITTER RECEIVERS
Transmitter receiver system for Helios solar probe using coherent phase modulation
c07 N72-21162

TRANSMITTERS
Battery powered aircraft crash locator transmitter
[NASA-CASE-MFS-16609] c14 N72-21431

TRANSONIC SPEED
Wind tunnel tests of M2-F2 lifting body entry configuration at transonic and supersonic speeds and selected Reynolds numbers
[NASA-TM-X-2511] c02 N72-21005

TRANSPONDERS
Spacecraft transponder and ground station radar system for mapping planetary surfaces
[NASA-CASE-NPO-11001] c07 N72-21118

TRANSPORT PROPERTIES
Influence of fast neutron bombardment on transport properties of carriers in n-type germanium
[ORO-3651-10] c24 N72-21679
Temperature dependences of transport phenomena and electronic density of states at high temperatures for transition metals
c26 N72-21783
Transport properties of n-type alloys of GaP and ZnSe and their application to luminescent diodes
[NASA-CR-111997] c26 N72-21798

TRANSPORT THEORY
General transport rule for variable mass dynamics for current engineering systems such as rockets, powered space vehicles, jet aircraft, and ablating systems
c19 N72-21570

TRANSPORTATION
System capacity, station capacity, urban grid design, and headway requirements for personalized rapid transit systems
[PB-204801] c34 N72-21977
Transportation systems - bibliography
[PB-204803] c34 N72-21978

TRAVELING WAVE AMPLIFIERS
Analysis of interactions of spiral electron cluster in crossed field traveling wave amplifier
[AD-735435] c09 N72-21260

TREES [PLANTS]
Signal propagation at 400 kHz in oak trees using HEMAC
[AD-735330] c07 N72-21178

TRIETHYL COMPOUNDS
Triethyl aluminum as fuel or fuel additive for heat addition by external combustion hypersonic vehicle
[DLR-MITT-71-26] c28 N72-21822

TROPICAL METEOROLOGY
Report of second session of GARP Atlantic Tropical Experiment [GATE] for presentation of preliminary plan
[GARP-SPEC-5] c20 N72-21591

TROPICAL REGIONS
Penetration of high energy solar protons to ionospheric heights at magnetic equator
c29 N72-21834

TUNGSTEN
Effect of tungsten and molybdenum on softening and structure of chromium-nickel austenitic stainless steel
[AD-735466] c17 N72-21548
Thermodynamic properties of tungsten, niobium, and molybdenum
[AD-736039] c17 N72-21553
Band structure of tungsten in energy region of 5d bands by photoelectric spectroscopy
c26 N72-21725

TUNGSTEN ALLOYS
Cobalt-tungsten alloys with superior strength at elevated temperatures
[NASA-CASE-LEW-10436-1] c17 N72-21538

TUNGSTEN CARBIDES
Advantages of using tungsten carbides in commercial cemented carbides
[NLL-TRANS-746-1099-[9022.401]]
c06 N72-21091

TUNGSTEN COMPOUNDS
Density of states model applied to superconductivity problem in high transition temperature beta-tungsten superconductors
[NASA-CR-126047] c26 N72-21793

TUNGUSK METEORITE
Origin of Tunguska meteorite, meteoritic fallout, and radio wave studies of meteors
[NLL-M-22218-[5828.4F]] c30 N72-21856

TURBINE BLADES
Development of procedures for determining strength of cast turbine blades under variable load conditions
[JPRS-55555] c28 N72-21818
Numerical analysis of oscillatory aerodynamic forces and moments acting on cascade of airfoils in unstalled conditions
[AD-735205] c28 N72-21825

TURBOFAN ENGINES
Characteristics of aircraft using supercritical aerodynamics and analysis of turbofan engine performance with single and double stage configurations
[NASA-TM-X-68031] c28 N72-21816

TURBOJET ENGINE CONTROL
Analog and digital computer simulation analysis of performance and control of low-pressure-ratio turbojet engine for drone aircraft
[NASA-TM-X-2537] c28 N72-21817

TURBOJET ENGINES
Numerical analysis of parameters in multistage gas turbine engines and components
[AD-736489] c28 N72-21827

TURBOMACHINERY
Numerical analysis of oscillatory aerodynamic forces and moments acting on cascade of airfoils in unstalled conditions
[AD-735205] c28 N72-21825

TURBULENT BOUNDARY LAYER
Experimental pitot probe displacement measurements in supersonic turbulent boundary layer
[NASA-TN-D-6759] c12 N72-21313

TURBULENT FLOW
Computer program for solving compressible nonsimilar boundary layer equations for laminar, transitional, or turbulent flows of perfect gas
[NASA-TM-X-2458] c12 N72-21312
Turbulent flow model for estimating sound level
[AD-735922] c12 N72-21327
Momentum and heat transfer in turbulent flow of air in fuel assembly model
[ZJE-111] c22 N72-21651

TURBULENT WAKES
Development of active and passive techniques for detecting and measuring presence and intensity of wingtip vortices generated in airport areas
[DOT-TSC-FAA-72-13] c02 N72-20999

Computer program and numerical analysis of feasibility of using suction between and along runways to remove trailing edge vortex streets
[IDA-LOG-HQ-69-10164] c11 N72-21290

**TWO DIMENSIONAL FLOW**
Higher-order theory used for solution of two dimensional subsonic wall interference due to source and vortex between perforated wind tunnel walls
[AD-735967] c11 N72-21307
Numerical analysis of one dimensional momentum flux and comparison with experimental value for range of two phase flow conditions
[NASA-TM-X-68038] c12 N72-21311
Numerical conversion of three dimensional stationary detached flow to two dimensional nonstationary detached flow about flat bodies
[AD-735604] c12 N72-21322

**TYPE 3 BURSTS**
Simultaneous IMP 6 observations of anisotropic packet of low-energy solar electron intensities and of type 3 solar radio burst
[NASA-CR-125932] c29 N72-21828
Interplanetary proton and electron data used to study association of particle data with type 3 solar radio bursts in dekametric band
c29 N72-21845

## U

**U.S.S.R.**
Development of Soviet aviation from prerevolution to 1970
[AD-735204] c02 N72-21019
Abstracts on space biology and medicine involved in cosmonaut training
[JPRS-55687] c04 N72-21043
Calendar days with 30 mm or more rain in 24 hour period - northwest U.S.S.R.
[NLL-M-22061-[5828.4F]] c20 N72-21586

**UH-1 HELICOPTER**
Relative incidence and cost data for orientation-error accidents in regular Army UH-1 aircraft during fiscal year 1968
[AD-735457] c02 N72-21016

**ULTRAHIGH FREQUENCIES**
Variable frequency microwave spacecraft antenna
[NASA-CASE-NPO-11264] c07 N72-21155
Ultrahigh frequency references containing materials property data in millimeter and submillimeter ranges
[AD-735621] c09 N72-21269

**ULTRAHIGH VACUUM**
Material outgassing, vapor sorption, and thin film spreading at sources of spacecraft contamination and effects on spacecraft performance in ultrahigh vacuum
c31 N72-21896
Ultrahigh vacuum for determining effects of hydrogen on fatigue and fracture properties of Ni 200
c14 N72-21916

**ULTRASONIC RADIATION**
Matrix element of solid state ultrasonic image converter using light emitting diode in nonscanning display for acoustic imaging of underwater objects
[AD-736535] c09 N72-21272

**ULTRASONIC TESTS**
Ultrasonic scanning system for in-place inspection of brazed steel tube joints
[NASA-CASE-MFS-20767] c15 N72-21482

**ULTRAVIOLET RADIATION**
Absorption spectra of atmospheric gases in vacuum ultraviolet regions
[NLL-M-22123-[5828.4F]] c13 N72-21352

**ULTRAVIOLET SPECTRA**
Vacuum ultraviolet multiplets for ionized carbon and oxygen, and absolute emission cross sections
[NASA-TM-X-65864] c24 N72-21676
Analysis of strongest solar ultraviolet emission lines of Mg II, O I, C II, AND C III and atmospheric model development
[NASA-CR-125981] c29 N72-21829

**UNDERGROUND EXPLOSIONS**
Ground motion predictions for Rio Blanco explosion
[NVO-1163-228] c13 N72-21369

**UNDERWATER ACOUSTICS**
Matrix element of solid state ultrasonic image converter using light emitting diode in nonscanning display for acoustic imaging of underwater objects
[AD-736535] c09 N72-21272

**UNDERWATER EXPLOSIONS**
Effect of wave overtaking on peak pressure of refracted underwater explosion shock waves
[AD-735875] c12 N72-21324

**UPPER ATMOSPHERE**
Particle precipitation in polar upper atmosphere
c07 N72-21122
Proceedings of institute for aurora and airglow investigations during 1970
[AD-735151] c13 N72-21384
Meteorological data for Lance launching
[AD-735364] c20 N72-21596
Meteorological parameters for Honest John missile launch
[AD-735362] c20 N72-21597
Solar radiation, cosmic rays, satellite orbits, and upper atmosphere structure - bibliography
c34 N72-21975

**URANIUM ISOTOPES**
Geochemical studies using Th and U isotopes as geological indices in marine environments
[ORO-3622-12-PT-1] c13 N72-21366

**URANIUM 235**
Gamma ray assay for verifying U-235 content in fuel pins
[ANL-7839] c22 N72-21657

**URBAN DEVELOPMENT**
Review of land use models and application of specific models for various aspects of urban planning and development
c34 N72-21971
Development of concept for deterministic design of urban space allocation and urban transportation system
c34 N72-21972

**URBAN PLANNING**
Review of land use models and application of specific models for various aspects of urban planning and development
c34 N72-21971
Development of concept for deterministic design of urban space allocation and urban transportation system
c34 N72-21972

**URBAN RESEARCH**
Review of land use models and application of specific models for various aspects of urban planning and development
c34 N72-21971

**URBAN TRANSPORTATION**
Development of concept for deterministic design of urban space allocation and urban transportation system
c34 N72-21972

**UTILITY AIRCRAFT**
Briefs of US general aviation accidents involving aerial application operations during 1969
[PB-204811] c02 N72-21025

## V

**V/STOL AIRCRAFT**
Stability and control flight test procedures for V/STOL aircraft in general and specific application to P-1127 and Harrier aircraft
c02 N72-20980
Airborne simulator used to determine lateral-directional handling qualities for V/STOL aircraft in low speed maneuvering flight
[AD-735420] c02 N72-21014
Design problems of inlets and nozzles used in supersonic and V/STOL propulsion systems
[NASA-TM-X-67741] c28 N72-21819

**VACUUM APPARATUS**
Portable vacuum surface probe for sampling spacecraft surface for microorganisms
[NASA-CASE-LAR-10623-1] c14 N72-21415

**VACUUM EFFECTS**
Analysis of microdensitometer measurements of Apollo 12 photographs of clouds caused by venting liquids into space
[NASA-CR-125934] c31 N72-21885

**VACUUM PUMPS**
Application of explosive driven magnetohydrodynamics for producing pulses at multimegajoule levels
[AD-735660] c15 N72-21497

**VALENCE**
Ultraviolet photoemission methods of determining density of valence and conduction states
[NASA-CR-126040] c26 N72-21720
Soft X ray spectroscopic method for recording L series valence band spectra in iron, cobalt, nickel, copper, and zinc
[NASA-CR-126042] c26 N72-21742

**VALVES**
Valve sealing performance in fluorinated oxidizers
[AD-735286] c15 N72-21494

**VANADIUM**
Oxygen effects in static sodium on vanadium and vanadium alloys, using internal oxygen theory
[ORNL-4739] c06 N72-21108

**VAPORS**
Apparatus which separately evaporates halides and mixes vapors
c15 N72-21521

**VARIABLE MASS SYSTEMS**
General transport rule for variable mass dynamics for current engineering systems such as rockets, powered space vehicles, jet aircraft, and ablating systems
c19 N72-21570

**VARIATIONAL PRINCIPLES**
Structural stability analysis of elastic plates with finite element method based on expanded variational principles
c32 N72-21935

**VECTOR MESONS**
Electron-positron storage rings noting QED, vector meson, and hadronic experiments
[NOTA-INTERNA-343] c24 N72-21686

**VECTOR SPACES**
Algorithm for approximate solution of vector Toeplitz systems
[UCRL-73495] c19 N72-21571

**VEHICLE WHEELS**
Effect of pore pressures on soil-wheel interaction
[AD-735792] c32 N72-21942

**VELOCITY MEASUREMENT**
Instrument for measuring magnitude and direction of flow velocity in flow field
[NASA-CASE-LAR-10855-1] c14 N72-21417

**VENTILATION**
Ventilation systems for 33-foot diameter space station and 14-foot diameter modular space station
[NASA-CR-123593] c31 N72-21879

**VENTING**
Analysis of microdensitometer measurements of Apollo 12 photographs of clouds caused by venting liquids into space
[NASA-CR-125934] c31 N72-21885

**VENUS [PLANET]**
Cloud characteristics on Venus from visual, photometric, polarization, spectrometric, and radio measurements
[AD-734919] c30 N72-21875

**VENUS ATMOSPHERE**
Weak solar wind shock heating of comet coma and Venus atmosphere
[TRITA-EPP-72-02] c29 N72-21851

**VERTICAL DISTRIBUTION**
Vertical and horizontal distributions of atmospheric kinetic energy in June and Jan. over northern and southern USSR
[NLL-M-22049-[5828.4F]] c20 N72-21581

**VERTICAL TAKEOFF AIRCRAFT**
Application of programmed pilotage techniques to vary aerodynamic parameters during flight for enhancement of level flight speed characteristics of VTOL aircraft
[AD-736537] c02 N72-21032

**VERY HIGH FREQUENCIES**
Utilization of natural plant growth to model HF-VHF radio transmission in jungle forest type terrain
[AD-735335] c07 N72-21180

**VERY LOW FREQUENCIES**
Solar electron and proton measurements in interplanetary space and magnetotail during onset of solar particle event, and comparison with continuous transpolar VLF data
[AD-736430] c29 N72-21855

**VESTIBULAR TESTS**
Indirect measurement of primate vestibular system function through analysis of vestibulo-ocular reflex response to various input stimuli
[AD-734545L] c04 N72-21065

**VIBRATION MEASUREMENT**
Application of mean square approximation system for determining structural vibrations and frequency variability
[NASA-CR-1961] c32 N72-21933

**VIBRATION MODE**
Function generator for producing complex vibration mode patterns used to identify vibration mode data
[NASA-CASE-LAR-10310-1] c10 N72-21275

**VIBRATION SIMULATORS**
Equipment for vibration testing of assemblies, components, and other articles
[NASA-CASE-GSC-11302-1] c14 N72-21435

**VIBRATION TESTS**
Wind tunnel balance system for determining wind-induced vibrations in space shuttle model
[NASA-CR-115531] c11 N72-21288
Equipment for vibration testing of assemblies, components, and other articles
[NASA-CASE-GSC-11302-1] c14 N72-21435

**VIBRATIONAL STRESS**
Clinical treatment of vibration induced disorders in construction workers
[RAE-LIB-TRANS-1611] c04 N72-21051

**VIDICONS**
Effect of background photon flux density on performance of infrared vidicons and infrared scanning systems
[AD-735324] c07 N72-21186

**VINYL POLYMERS**
Wear resistance and durability of coatings from dry polyvinyl butyral paint SVL-21
[AD-735238] c18 N72-21562

**VISCOELASTICITY**
Method for determining wave attenuation in composite materials due to viscoelasticity
[AD-734658] c18 N72-21559

**VISCOMETRY**
Development of procedure for measuring coefficient of dynamic viscosity of liquids based on speed of plate moving through liquid
[AD-735640] c14 N72-21455
**VISCOSITY**
Development of procedure for measuring coefficient of dynamic viscosity of liquids based on speed of plate moving through liquid
[AD-735640] c14 N72-21455
Numerical process for analyzing and summarizing fluid viscosity data over extended temperature ranges
[AD-735270] c15 N72-21499
**VISCOUNT AIRCRAFT**
Investigation of fire aboard Vickers Viscount aircraft following landing at Honolulu, Hawaii on 8 August, 1971
[NTSB-AAR-72-2] c02 N72-21003
**VISIBILITY**
Techniques for measuring and monitoring slant visibility of pilots landing aircraft in fog and haze
[DOT-TSC-FAA-71-25] c02 N72-20998
**VISUAL ACUITY**
Human visual acuity measured by chromatic square wave gratings under luminance conditions
[AD-734931] c04 N72-21063
**VISUAL FIELDS**
Automated visual sensitivity tester for determining visual field sensitivity and blind spot size
[NASA-CASE-ARC-10329-1] c05 N72-21079
**VISUAL FLIGHT RULES**
Planning and management of air traffic control system based on random sample of flight plans filed at flight service stations during calendar year 1970
[AD-735970] c21 N72-21641
**VISUAL PERCEPTION**
Medical research abstracts on limulus visual system, electronic neuron model development, and auditory adaptation in horseshoe crab
[AD-734017] c04 N72-21073
**VOLTAGE AMPLIFIERS**
Wide range analog to digital converter with variable gain amplifier
[NASA-CASE-NPO-11018] c08 N72-21200
DC/DC converter for space application using linear analog to pulse width conversion in control loop to gain amplified regulated voltage
[ESRO-TN-105-ESTEC] c09 N72-21258
**VOLTAGE REGULATORS**
Switching type voltage regulator with relatively simple circuit arrangement
[NASA-CASE-LEW-11005-1] c09 N72-21243
**VORTEX RINGS**
Vortex ring method used for calculations of aerodynamic characteristics of helicopter lifting rotors at any angle of attack in flow with comparatively high velocity
[AD-735439] c01 N72-20973
**VORTEX STREETS**
Development of active and passive techniques for detecting and measuring presence and intensity of wingtip vortices generated in airport areas
[DOT-TSC-FAA-72-13] c02 N72-20999
Computer program and numerical analysis of feasibility of using suction between and along runways to remove trailing edge vortex streets
[IDA-LOG-HQ-69-10164] c11 N72-21290
**VORTICES**
Wind tunnel analysis of factors affecting wing tip vortex
[NASA-TM-X-2516] c01 N72-20970
Higher-order theory used for solution of two dimensional subsonic wall interference due to source and vortex between perforated wind tunnel walls
[AD-735967] c11 N72-21307


## W


**WAR GAMES**
Antiaircraft defense, including reliability and efficiency of radar data, tactics exercise, and recording equipment parameters
[AD-735425] c34 N72-21980
SATAN 2 computer program modification to include counter battery operations, multifire, and simultaneous fire
[AD-735962] c34 N72-21982
**WARNING SYSTEMS**
Pilot warning indicator system
[NASA-CASE-ERC-10226-2] c02 N72-21008
Evaluation of oxygen-sensing warning device for use in damage control suit system
[AD-735377] c05 N72-21082
Vertically stacked collinear array of independently fed omnidirectional antennas for use in collision warning systems on commercial aircraft
[NASA-CASE-LAR-10545-1] c09 N72-21244
**WATER EROSION**
Numerical analysis and theoretical discussion of effects of high velocity liquid impact and cavitation flow
c12 N72-21314
**WATER MANAGEMENT**
Appraisal of adequacy of hydrometeorological information in western basins for water resources planning
[PB-204939] c20 N72-21609
**WATER MODERATED REACTORS**
Insulation tests for prestressed concrete reactor vessels of water reactors
[CONF-710903-6] c22 N72-21652
**WATER POLLUTION**
Measurement and control of radioactive wastes in environment, soil, and water
[CONF-711113-3] c22 N72-21653
**WATER TEMPERATURE**
Oceanographic and climatic influence on Indian Ocean thermal structures in upper layers
[AD-734668] c13 N72-21378
Anomalies in North Atlantic Ocean temperature and ocean-atmosphere temperature differences preceding and during severe 1968-1969 winter
[NLL-M-22215-[5828.4F]] c20 N72-21583
Annual and secular variations of North Atlantic temperature, based on data for 1881 through 1962
[NLL-M-22214-[5828.4F]] c20 N72-21584
**WATER WAVES**
Spectral characteristics of wind driven waves over small areas of water
[RAE-LIB-TRANS-1634] c13 N72-21363
**WAVE ATTENUATION**
Prediction theories for shock wave attenuation in porous materials
[AD-735761] c12 N72-21326
Method for determining wave attenuation in composite materials due to viscoelasticity
[AD-734658] c18 N72-21559
**WAVE EQUATIONS**
Wave equations for determining scattering of sound from layered hollow elastic cylinders
[AD-735859] c23 N72-21670
**WAVE FRONT DEFORMATION**
Analysis of mirror wave front distortions caused by Gaussian distributed laser radiation
[AD-735282] c23 N72-21668
**WAVE FUNCTIONS**
Behavior of electron wave functions near atomic nucleus and normalization screening theory in atomic photoeffect
[NYO-3829-75] c24 N72-21678
**WAVE PROPAGATION**
Characteristics and effects of Arctic ionosphere on radio and radar propagation - conference
[AGARD-CP-97] c07 N72-21121
Power spectral densities, Doppler shifts, and phase fluctuations of frequency distortion in auroral HF propagation
c07 N72-21143
Multiple scattering effects of wave propagation in isotropic scattering media with solution of equations for coherent field and average intensity
[AD-735284] c07 N72-21169
Ionospheric storm effect comparison over eight oblique sounder paths
[AD-735868] c07 N72-21175
Effect of wave overtaking on peak pressure of refracted underwater explosion shock waves
[AD-735875] c12 N72-21324
Meso-scale waves in jet stream and effect of gravity inertial waves
[NLL-M-22060-[5828.4F]] c13 N72-21353
Acoustic and internal gravity wave propagation and turning points
[AD-735386] c13 N72-21381
Estimation of beam spread of laser beam propagating in turbulent medium
[AD-735665] c16 N72-21508
**WAVE REFLECTION**
Partial reflections of radio waves from lower ionosphere
[NASA-TN-D-6742] c13 N72-21361
**WAVEGUIDES**
Resonators for diplexers in multiplexing network noting bandpass filters and coplanar waveguides
[ESRO-CR-46] c07 N72-21164
**WEAPON SYSTEMS**
Uniformity theorems for purchase of defensive weapon systems
[AD-735260] c34 N72-21985
**WEAR INHIBITORS**
Wear resistance and durability of coatings from dry polyvinyl butyral paint SVL-21
[AD-735238] c18 N72-21562
**WEATHER**
Compilation of United States general aviation accidents involving weather as cause or cause related factor year 1969
[PB-204926] c02 N72-21026
**WEATHER FORECASTING**
Calendar days with 30 mm or more rain in 24 hour period - northwest U.S.S.R.
[NLL-M-22061-[5828.4F]] c20 N72-21586
Mathematical models for determining influence of weather forecasts on military operational decisions
[AD-735261] c20 N72-21602
Automated forecasting of clear air turbulence by multidimensional contingency tables
[AD-735941] c20 N72-21604
Computer produced diurnal temperature and dew point tables and curves and their use in short-range weather forecasting
[AD-735276] c20 N72-21614
Reference file for aiding weather forecasts at Loredo AFB, Texas
[AD-735791] c20 N72-21615
**WEATHER MODIFICATION**
Appraisal of adequacy of hydrometeorological information in western basins for water resources planning
[PB-204939] c20 N72-21609
**WEIGHTLESSNESS**
Apparatus for mixing two or more liquids under zero gravity conditions
[NASA-CASE-LAR-10195-1] c15 N72-21488
**WEIGHTLESSNESS SIMULATION**
Parametric analysis of intravehicular manned cargo transfer in simulated weightlessness
[NASA-TN-D-6774] c05 N72-21075
**WELD TESTS**
Method and apparatus for testing integrated circuit microtab welds
[NASA-CASE-ARC-10176-1] c15 N72-21464
**WELDED JOINTS**
Radiographic indications film interpreter might encounter during evaluation of aluminum alloy welds
[NASA-CR-123488] c15 N72-21467
Ultrasonic scanning system for in-place inspection of brazed steel tube joints
[NASA-CASE-MFS-20767] c15 N72-21482
Microstructure and stress corrosion behavior of welded steel joints
c14 N72-21910
Failure of welded joints in Ti-Al-Sn alpha type alloys in CCl4 vapor
c32 N72-21929
**WELDED STRUCTURES**
Preparation and mechanical properties of austenitic stainless steel weldments
[HEDL-TME-71-118] c15 N72-21490
**WELDING**
Laboratory equipment for testing welded seams of thin walled shells
[AD-735925] c32 N72-21945
**WETTING**
Interaction and marginal wetting angles of chromium and titanium borides with iron and nickel
c17 N72-21518
**WIND [METEOROLOGY]**
Relationship between sand flow and wind friction, and vertical density distribution of sand
[NASA-TT-F-14215] c13 N72-21359
**WIND EFFECTS**
Spectral characteristics of wind driven waves over small areas of water
[RAE-LIB-TRANS-1634] c13 N72-21363
Computerized simulation of Skylab 1B vehicle response to winds during propellant loading at launch pad for determining displacements and bending moments
[NASA-CR-123564] c31 N72-21878
**WIND PROFILES**
Wind velocity profiles measured by smoke trail technique at Eastern Test Range during 1964
[NASA-TN-D-6746] c20 N72-21589
Measurement of wind and temperature profiles and turbulent fluctuations in wind velocity under homogeneous turbulence
[AD-735393] c20 N72-21603
**WIND TUNNEL APPARATUS**
Evaluation of static-pressure measuring probes used in wind tunnel tests at supersonic and hypersonic speeds
[AD-736017] c14 N72-21461
**WIND TUNNEL MODELS**
Wind tunnel analysis of factors affecting wing tip vortex
[NASA-TM-X-2516] c01 N72-20970
Wind tunnel tests of M2-F2 lifting body entry configuration at transonic and supersonic speeds and selected Reynolds numbers
[NASA-TM-X-2511] c02 N72-21005
Problems in aerodynamics of sustained hypersonic flight
[NASA-TT-F-14235] c02 N72-21006
Blade stress analysis, wind tunnel models, and test procedures for investigating conversion process of folding tilt-rotor aircraft - Vol. 4
[AD-735733] c02 N72-21028
Wind tunnel balance system for determining wind-induced vibrations in space shuttle model
[NASA-CR-115531] c11 N72-21288
**WIND TUNNEL STABILITY TESTS**
Comparison of flight test and wind tunnel data to determine areas of agreement when nonlinearities appear in aerodynamic coefficients of slender wing aircraft
c02 N72-20990

Longitudinal and lateral aerodynamic characteristics of scale model of GD/C aerospace shuttle booster in wind tunnel force tests
[NASA-CR-119992] c31 N72-21886
Aerodynamic wind tunnel stability tests for determining fin deflection angle and vertical position of frustrum of space shuttle at high angles of attack
[NASA-CR-120040] c31 N72-21889
WIND TUNNEL WALLS
Higher-order theory used for solution of two dimensional subsonic wall interference due to source and vortex between perforated wind tunnel walls
[AD-735967] c11 N72-21307
WIND VELOCITY
Measurement of wind and temperature profiles and turbulent fluctuations in wind velocity under homogeneous turbulence
[AD-735393] c20 N72-21603
WIND VELOCITY MEASUREMENT
Wind velocity profiles measured by smoke trail technique at Eastern Test Range during 1964
[NASA-TN-D-6746] c20 N72-21589
WING TIPS
Wind tunnel analysis of factors affecting wing tip vortex
[NASA-TM-X-2516] c01 N72-20970
WINGS
Dual fuselage aircraft design with yawable wing and horizontal stabilizer
[NASA-CASE-ARC-10470-1] c02 N72-21010
WINTER
Anomalies in North Atlantic Ocean temperature and ocean-atmosphere temperature differences preceding and during severe 1968-1969 winter
[NLL-M-22215-[5828.4F]] c20 N72-21583
Winter orographic cloud modification seeding experiment in Colorado mountains
[PB-205277-F] c20 N72-21599

## X

X RAY ASTRONOMY
Soft X ray survey of galactic plane from Sagittarius to Vela
[UCRL-51090] c30 N72-21872
X RAY FLUORESCENCE
Soft X ray emission from alloys of aluminum with silver, copper, and zinc and comparison with conditions of simple metal alloyed with noble metal
c26 N72-21740
Measurement of soft X ray emission spectra for aluminum-magnesium alloys and comparison with spectra for pure metals
c26 N72-21741
X RAY IRRADIATION
Measurement of photoemission from thin films of europium and barium excited by vacuum ultraviolet and soft X ray radiation
c26 N72-21728
Numerical analysis of density of electron states in metals based on soft X ray transitions in solids
c26 N72-21731
Development of numerical process for estimating enhancement factor on intensity of soft X ray emission in metals due to effect of core hole
c26 N72-21733
Analysis of soft X ray spectra in light metals and development of theory for emission and absorption cancellation effects
c26 N72-21734
Measurement of effects produced by modulation of emission band of polycrystalline copper by alternating elastic strain
c26 N72-21736
Application of soft X ray band spectra to determine similarities and differences between one electron spectrum and density of states
c26 N72-21737
Soft X ray emission from alloys of aluminum with silver, copper, and zinc and comparison with conditions of simple metal alloyed with noble metal
c26 N72-21740
Measurement of soft X ray emission spectra for aluminum-magnesium alloys and comparison with spectra for pure metals
c26 N72-21741
X RAY SPECTROSCOPY
Very high resolution X ray spectrometry with cooled Si[Li] detectors and optoelectron preamplifier
[CEA-CONF-1840] c14 N72-21439
Electron density of states for noble and transition metals by X ray photoelectron spectroscopy
c26 N72-21722
Soft X ray spectroscopic method for recording L series valence band spectra in iron, cobalt, nickel, copper, and zinc
[NASA-CR-126042] c26 N72-21742
Application of soft X ray spectroscopy for determining electronic properties of titanium interstitial and intermetallic compounds
c26 N72-21743
Concave grating spectrometer analysis of emission band for silicon and energy range of emission band for germanium
c26 N72-21744
X ray photoelectron spectroscopic measurements of valence bands of AuAl2 and AuGa2, and gold 5d band dilemma
c26 N72-21796
X RAYS
Correlation of changes in Knight shift and soft X ray emission edge height of aluminum in Al metal, alloys, and oxide
c26 N72-21780

## Z

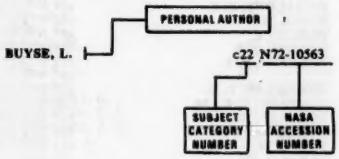
ZINC
Thermal expansion coefficient of activated vacancy in Zn and Cd
[RPI-3820-5] c17 N72-21545
ZINC ALLOYS
Transport properties of n-type alloys of GaP and ZnSe and their application to luminescent diodes
[NASA-CR-111997] c26 N72-21798
ZIRCONIUM
Structure of d-band for Sc, Ti and Zr in 4 to 11.6 eV range by photoemission spectroscopy
c26 N72-21726
ZIRCONIUM ALLOYS
Corrosion characteristics of seven zirconium alloys at 50 atm steam and 350 and 450 C
[AEC-TR-7287] c17 N72-21544
ZIRCONIUM OXIDES
Interaction process of ZrO2 with graphite powder
c18 N72-21520

# PERSONAL AUTHOR INDEX





## TYPICAL PERSONAL AUTHOR INDEX LISTING




Listings in this index are arranged alphabetically by personal author. The subject category number indicates the subject category in the abstract section in which the citation is located. The NASA accession number denotes the number by which the citation is identified within the subject category.

## A


AARONS, J. c07 N72-21138
c07 N72-21150
AAS, S. c22 N72-21650
ABERNATHY, F. A. c11 N72-21290
ACKERMAN, J. P. c03 N72-21039
ADLER, D. c26 N72-21763
AGADZHANYAN, N. A. c04 N72-21044
AGY, V. c07 N72-21153
AHLSWEDE, M. c28 N72-21822
AJZENBERG, L. A. c19 N72-21566
ALADEV, I. T. c33 N72-21957
ALBERS, W. A., JR. c26 N72-21716
ALDREDGE, J. L. c04 N72-21061
ALEXANDER, I. M. c07 N72-21164
ALEXOPOULOS, N. G. c23 N72-21674
ALLEN, C. W. c15 N72-21469
ALLEN, E. M. c12 N72-21328
ALLEN, G. E. c31 N72-21879
ALLEN, J. M. c12 N72-21313
ANDERSON, C. W. c21 N72-21638
ANDERSON, G. F. c12 N72-21320
ANDERSON, G. M. c21 N72-21633
ANDERSON, J. D., JR. c16 N72-21509
ANDERSON, W. E. c32 N72-21901
ANDERSON, W. J. c15 N72-21470
ANDREWS, L. J. c08 N72-21215
ANTHONY, D. c13 N72-21394
APGAR, E. G. c14 N72-21449
APRILLE, T. J., JR. c08 N72-21232
ARCHER, D. D. c02 N72-20977
ARLINGHAUS, F. J. c26 N72-21716
ARMSTRONG, S. M. c11 N72-20994
ARNOLDOV, M. N. c17 N72-21547
ARTSISHEVSKII, M. A. c17 N72-21514
ASCHKENASY, E. c07 N72-21182
ASHBROOK, R. L. c15 N72-21485
ASHCROFT, N. W. c26 N72-21719
ATHANS, M. c07 N72-21120
AUDET, N. F. c05 N72-21082
AURIOL, A. c11 N72-21304
AZBUKINA, Y. N. c13 N72-21364


## B


BABUSHKIN, A. A. c26 N72-21699
BACHMANN, W. c13 N72-21390
BADING, C. E. c21 N72-21642
BAGDON, V. U. c04 N72-21068
BAILEY, M. C. c09 N72-21244
BAIN, D. R. c18 N72-21561
BAIRD, E. D. c16 N72-21504
BAKER, C. D. c14 N72-21405
BAKER, R. C. c02 N72-21017
BALASHOV, B. F. c28 N72-21818
BALES, W. B. c34 N72-21982
BALMER, R. J. c02 N72-20980
BARACH, D. c16 N72-21505
BARBER, V. C. c13 N72-21398
BARCILON, V. c23 N72-21674
BARGMANN, R. c08 N72-21233
BARKER, R. C. c26 N72-21789
BARNES, C. E. c16 N72-21507
BARNETT, J. c07 N72-21187
BARNEY, W. C. c13 N72-21379
BARREAU, D. c07 N72-21149
BARRETT, J. c13 N72-21374
BARRINGTON, A. E. c14 N72-21452
BASIN, A. S. c17 N72-21547
BASOV, N. G. c25 N72-21698
BASTRESS, E. K. c02 N72-21017
BATES, H. F. c07 N72-21147
BATES, M. R. c21 N72-21625
BAUMEISTER, K. J. c12 N72-21311
c33 N72-21953
BAZILEVSKIY, A. T. c30 N72-21865
BEAGLEHOLE, D. c17 N72-21706
c26 N72-21769
BEASLEY, G. P. c05 N72-21075
BEBB, J. c08 N72-21208
BECK, P. A. c26 N72-21771
BECKETT, C. W. c17 N72-21553
BEEBE, T. c05 N72-21085
BEEBY, J. L. c26 N72-21758
BEERMAN, H. P. c14 N72-21427
BELKNAP, S. B. c19 N72-21570
BELL, M. I. c26 N72-21792
BELLANTONI, J. F. c02 N72-20997
c21 N72-21630
BELLMAN, D. R. c28 N72-20983
BELLOT, J. c32 N72-21924
BEMENT, L. J. c33 N72-21955
BENDER c13 N72-21362
BENNETT, L. H. c17 N72-21540
c26 N72-21702
c26 N72-21776
c26 N72-21780
BERANEK, B. c13 N72-21342
BERFIELD, R. G. c08 N72-21224
BERG, E. c13 N72-21367
BERGAN, P. G. c32 N72-21938
BERGERSEN, B. c26 N72-21734
BERGEY, G. E. c05 N72-21084
BERMAN, H. c31 N72-21892
BERNATOWICZ, D. T. c03 N72-21033
BERNHART, W. J. c08 N72-21227
BERUKSHTIS, G. K. c17 N72-21530
BIEFER, G. J. c14 N72-21911
BIELOZEROVA, V. P. c13 N72-21352
BIRCHENOUGH, A. G. c09 N72-21243
BISGOOD, P. L. c02 N72-20990
BISHOP, G. J. c21 N72-21627
BITO, J. c25 N72-21696
BLACHON, J. c11 N72-21297
BLACKBURN, L. D. c15 N72-21490
BLAKE, J. B. c29 N72-21837
c29 N72-21855
BLAKE, W. K. c32 N72-21944
BLAUVELT, D. H. c08 N72-21220
BLEVINS, D. R. c31 N72-21887
BLEWETT, P. J. c12 N72-21319
BLINOVA, E. N. c20 N72-21623
BLOMEKE, J. O. c22 N72-21648
BOCK, J. K. c31 N72-21898
BOERSTOEL, J. W. c01 N72-20972
BOGDANOFF, J. L. c32 N72-21933
BOGUSLAVSKII, I. A. c21 N72-21637
BOICHUK, O. P. c21 N72-21643
BOLDRIGHINI, C. c24 N72-21688
BOLLANI, G. c14 N72-21918
BONDELID, R. O. c14 N72-21442
BOOTH, F. W. c15 N72-21488
BORGIA, B. c24 N72-21689
BORST, W. L. c24 N72-21676
BOUGHTON, R. I. c26 N72-21787
BOWDITCH, D. N. c28 N72-21819
BOWEN, D. C. c13 N72-21375
BOX, G. E. P. c19 N72-21578
BOYD, W. K. c17 N72-21927
BRAAKSMA, J. P. c34 N72-21970
BRADBURY, J. N. c13 N72-21384
BRADFIELD, E. N. c02 N72-21007
BRADLEY, P. A. c07 N72-21145
BRANDENBURG, R. W. c22 N72-21657
BRATTENG, O. c07 N72-21140
BRAUDAWAY, G. W. c08 N72-21217
BREIG, E. L. c13 N72-21400
BREY, H. c07 N72-21160
BRIDLE, A. H. c29 N72-21853
BRIGHT, C. W. c18 N72-21556
BRODEN, G. c26 N72-21728
BRODERICK, A. J. c20 N72-21592
BRODERSEN, R. W. c18 N72-21707
BRODOV, A. A. c17 N72-21514
BROPHY, J. J. c26 N72-21805
BROUERS, F. c26 N72-21734
c26 N72-21767
BROWN, A. G. c26 N72-21761
BROWN, G. L. c14 N72-21459
BROWN, W. L. c29 N72-21831
BROWNFIELD, A. W. c21 N72-21642
BROWNSON, J. J. c02 N72-21005
BRUCE, R. A. c15 N72-21488
BRUENER, H. c04 N72-21053
BSCHORR, O. c02 N72-21011
BUCHA, V. c13 N72-21347
BUCKLEY, E. P. c05 N72-21085
BULLINGER, H. B. c06 N72-21094
BUNKER, E. R., JR. c09 N72-21246
BURATTI, M. c32 N72-21931
BURCHAM, F. W., JR. c28 N72-20983
BURDET, C. c19 N72-21572
BURGINYON, G. c30 N72-21872
BURGNER, G. c28 N72-21817
BURMISTROV, V. P. c14 N72-21437
BURNHAM, D. c02 N72-20999
BURROUS, C. N. c09 N72-21249
BURSA, M. c13 N72-21333
c13 N72-21346
BUSS, D. D. c26 N72-21717
BUSSGANG, J. J. c07 N72-21181
BUTLER, R. D. c15 N72-21499
BUTLER, W. H. c26 N72-21759
BYRD, J. S. c14 N72-21443
BYRD, N. R. c06 N72-21105
BYRNE, F. c09 N72-21247


## C


CABRERA, B. c26 N72-21806
CADES, S. B. c05 N72-21081
CAIRNS, E. J. c03 N72-21039
CALOGERO, F. c24 N72-21684
CAMIZ, P. c24 N72-21685
CAMPBELL, D. V. c07 N72-21172
CANNON, L. E., III c19 N72-21577
CAPEL, A. c09 N72-21258
CAPLETTE, R. K. c08 N72-21199
CARBALLES, M. c26 N72-21802
CARDONA, M. c26 N72-21713
CARO, P. W. c05 N72-21080
CARON, L. G. c26 N72-21768
CARPINI, T. D. c14 N72-21417
CARTER, F. L. c26 N72-21751
CARTER, G. C. c26 N72-21776
CARTER, W. V. c31 N72-21888
CASSIDY, J. F. c33 N72-21952
CAUDILL, L. c16 N72-21503
CAVENY, L. H. c28 N72-21823
CAVONIUS, C. R. c04 N72-21063
CERADINI, F. c24 N72-21689
CERESUELA, R. c02 N72-21006
CERVENY, V. c13 N72-21341
CESCHINI, L. J. c32 N72-21914
CHAIT, R. c17 N72-21552
CHAN, P. D. c26 N72-21796
CHANG, Z. F. c09 N72-21268
CHAPPELL, C. R. c13 N72-21388
CHASEN, M. H. c04 N72-21065
CHASSIAN, C. c32 N72-21929
CHECINSKA, H. c17 N72-21515
CHEKALIN, S. V. c25 N72-21698
CHEN, A. T. F. c13 N72-21396
CHEN, E. S. c17 N72-21549
CHENG, C. c33 N72-21960
CHERTOV, S. A. K., YU.I. c17 N72-21514
CHERVYAKOV, A. Y. c06 N72-21524
CHESTNUT, W. G. c07 N72-21126
c07 N72-21129
CHING, B. K. c13 N72-21397
c13 N72-21400
CHIPMAN, E. c29 N72-21829
CHITTY, W. H. c31 N72-21891

CHO, S. J. c26 N72-21715
CHOESSOW, G. J. c33 N72-21953
CIMBALNIK, M. c13 N72-21343
CLARK, A. A. c11 N72-20995
CLARK, H. E. c26 N72-21749
CLARK, M. S. c02 N72-21029
CLARK, W. G., JR. c32 N72-21914
CLAUER, A. H. c17 N72-21534
CLAUS, H. c26 N72-21771
CLAUSING, R. E. c06 N72-21096
CLEVINGER, G. S. c17 N72-21539
CLIFFORD, C. E. c22 N72-21654
CLOUGH, L. G. c09 N72-21252
CLOUGH, R. W. c32 N72-21936
COCKFIELD, R. W. c34 N72-21972
COCKS, F. H. c32 N72-21908
CODY, G. D. c26 N72-21793
COFFIN, T. c31 N72-21878
COHEN, D. J. c13 N72-21386
COHEN, M. H. c26 N72-21764
COHEN, R. W. c26 N72-21793
COLBURN, J. G. c13 N72-21378
COLE, N. C. c15 N72-21490
COLEMAN, J. T. c07 N72-21135
COLLINGS, E. W. c26 N72-21762
c26 N72-21775
COLLINS, T. C. c26 N72-21714
COLOMBO, G. V. c31 N72-21879
CONNES, J. c14 N72-21411
CONNES, P. c14 N72-21411
CONNOLLY, D. J. c13 N72-21361
CONNOLLY, J. P. c04 N72-21052
CONNOLLY, J. W. D. c26 N72-21704
c26 N72-21705
CONSERVA, M. c32 N72-21931
CONVERSI, M. c24 N72-21686
c24 N72-21689
COONAN, J. R. c21 N72-21630
COOPER, C. R. c02 N72-21031
COOPER, J. E. c03 N72-21040
COPPER, C. G. c22 N72-21645
COPPER, L. N. c26 N72-21760
CORBETT, J. J. c07 N72-21146
CORIOU, H. c17 N72-21543
CORMIER, R. J. c07 N72-21146
CORNWALL, J. M. c13 N72-21403
CORONITI, F. V. c13 N72-21403
COSTELLO, L. C. c04 N72-21064
COTTEREAU, M. c25 N72-21694
COULOPOULOS, W. D. c21 N72-21642
COUSSON, F. c11 N72-20993
COX, D. E. c06 N72-21106
c06 N72-21107
CRAGG, E. E. c19 N72-21575
c19 N72-21576
CRAIG, H. L., JR. c14 N72-21902
CRANE, R. C. c02 N72-20989
CRAWSHAW, D. D. c23 N72-21672
CREMER, L. c23 N72-21660
CRENSHAW, J. H. c08 N72-21213
CROCHET, M. c07 N72-21149
CROCHET, M. J. c06 N72-21114
CROSWELL, W. F. c09 N72-21244
CROTTY, F. C., JR. c07 N72-21189
CROWE, J. C. c14 N72-21441
CRUSHEVSKII, A. V. c17 N72-21546
CUTHILL, J. R. c26 N72-21739
c26 N72-21780

## D

DAILEY, C. L. c28 N72-21824
DAMON, E. K. c04 N72-21054
DANDREA, A. c24 N72-21685
DANE, D. H. c15 N72-21463
DANEK, G. J. c17 N72-21919
DAS, T. P. c23 N72-21708
c26 N72-21779
DAVIDOVSKII, V. G. c11 N72-21303
DAVIDSON, G. R. c06 N72-21106
c06 N72-21107
DAVIDSON, R. E. c30 N72-21859
DAVIS, H. L. c26 N72-21710
DAVIS, J. A. c17 N72-21909
DAVIS, M. M. c29 N72-21853
DAVIS, R. A., JR. c13 N72-21401
DAVIS, R. P. c21 N72-21642
DAVISON, S. G. c26 N72-21761
DAVY, J. G. c09 N72-21267
DE GOEIJ, J. J. M. c06 N72-21111
DE SANTIS, C. M. c07 N72-21173
DEAL, F. C. c14 N72-21429
DEAN, J. P. c13 N72-21375
DEBEVOISE, J. M. c31 N72-21886
DEBOO, G. J. c09 N72-21249
DECKER, R. M. c02 N72-20988
DEFIORE, T. A. c02 N72-21015
DEIASI, R. c06 N72-21104
DELORENZO, J. T. c14 N72-21438
DELOUIS, H. c14 N72-21411
DEMAISTRE, J. C. c07 N72-21149
DEMIDOV, G. V. c34 N72-21981
DENNEY, D. C. c02 N72-21027
DEPOURBAIX, M. c17 N72-21542
DEQUE, R. c02 N72-20978
DERAIGNIAC, B. c13 N72-21390
DESANTIS, R. c17 N72-21930
DEVAN, J. H. c06 N72-21108
DICKEY, D. H. c26 N72-21755
DILLON, R. S. c22 N72-21648
DIMEFF, J. c10 N72-21276
DIMMOCK, J. O. c07 N72-21186
DIRUSSO, E. c32 N72-21931
DISTEFANO, J. R. c17 N72-21541
DMITRENKO, D. A. c13 N72-21349
DMITRIEV, I. B. c17 N72-21547
DMITRIYEV, V. N. c15 N72-21495
DOBBYN, R. C. c26 N72-21739
c26 N72-21780
DOETSCH, K., JR. c02 N72-21014
DOIRON, H. H. c19 N72-21567
DONALDSON, R. W., JR. c14 N72-21433
DONDI, G. c11 N72-21293
DOSTE, R. c14 N72-21921
DOUGLAS, T. B. c17 N72-21553
DOW, W. c23 N72-21671
DRAGANOW, R. c02 N72-20981
DREHER, G. B. c15 N72-21491
DRESHFIELD, R. L. c17 N72-21538
DRESSELHAUS, G. c17 N72-21706
DRESSELHAUS, M. S. c17 N72-21706
c18 N72-21707
DRIVER, W. E. c33 N72-21954
DRUZHININ, I. I. c18 N72-21523
DUBIN, P. A. c30 N72-21869
DUBOVITSKAYA, N. V. c17 N72-21516
DUDA, R. O. c20 N72-21601
DUFF, K. J. c23 N72-21708
DUFFEK, W. c19 N72-21569
DUMMER, G. c26 N72-21782
DUNHAM, W. L. c21 N72-21642
DURNEY, A. C. c13 N72-21388
DWORETSKY, M. M. c30 N72-21876
DYBDAL, R. B. c07 N72-21194

## E

EASSON, R. M. c07 N72-21164
EASTMAN, D. E. c26 N72-21723
c26 N72-21726
EASTON, D. S. c06 N72-21096
ECKERT, E. R. G. c33 N72-21959
ECKSTEIN, M. C. c30 N72-21873
EDFORS, H. C. c09 N72-21261
EGELAND, A. c07 N72-21131
EHRENREICH, H. c26 N72-21794
EHRLICH, I. R. c02 N72-21012
EIBSCHUETZ, M. c06 N72-21106
c06 N72-21107
EISELE, D. F. c05 N72-21075
EISENBERGER, P. c26 N72-21746
EKERS, R. D. c29 N72-21854
EKSTROM, M. P. c19 N72-21571
ELBERMAN, E. J., JR. c29 N72-21855
ELJURI, E. c17 N72-21536
ELLER, H. H. c15 N72-21467
ELROD, B. D. c21 N72-21633
ELSBERRY, R. C. c13 N72-21393
EMELYANOV, A. N. c17 N72-21514
ENDERBY, J. E. c26 N72-21762
ENGLANDER, I. c21 N72-21634
ENGLISH, W. D. c33 N72-21962
ENGLUND, K. c14 N72-21445
EOFF, D. A. c34 N72-21982
EPSTEIN, E. E. c30 N72-21876
ERHARDT, J. R. c08 N72-21218
ERICKSON, W. D. c33 N72-21956
ERINGEN, A. C. c17 N72-21550
ERLBACH, E. c26 N72-21769
ERNST, G. E. c04 N72-21068
ESTES, M. F. c15 N72-21481
EUWEMA, R. N. c26 N72-21714
EVANS, J. E. c13 N72-21384
c13 N72-21388
EVANS, J. V. c13 N72-21387
EWALD, R. c33 N72-21950

## F

FABIAN, D. J. c26 N72-21740
FADLEY, C. S. c26 N72-21722
FARRELL, R. c09 N72-21253
FARTHING, W. H. c14 N72-21418
FAUST, J. C. c08 N72-21241
FEAY, B. A. c03 N72-21039
FEDOSIMOV, A. I. c25 N72-21698
FEDYNSKII, O. S. c33 N72-21957
FEDYNSKY, V. V. c30 N72-21856
FEEN, M. M. c07 N72-21174
FEINLEIB, J. c26 N72-21763
FEINSTEIN, L. c15 N72-21464
FELSMAN, W. O. c08 N72-21224
FERRANTE, J. c17 N72-21532
FEURZEIG, W. c05 N72-21090
FIELD, J. E. c12 N72-21314
FINE, T. I. c08 N72-21226
FISCHER, J. E. c26 N72-21752
FISHER, M. J. c08 N72-21231
c21 N72-21640
FITZGERALD, J. W. c05 N72-21079
FITZGERALD, W. D. c07 N72-21193
c09 N72-21264
FJELLESTAD, K. c22 N72-21650
FLAGGE, B. c09 N72-21248
FLETCHER, E. R. c04 N72-21054
FLETCHER, N. H. c34 N72-21982
FOGAL, G. L. c05 N72-21074
FOGARTY, W. G. c30 N72-21876
FOLEY, D. H. c08 N72-21241
FOMALONT, E. B. c29 N72-21853
FONER, S. c26 N72-21777
FORGIE, J. c07 N72-21187
FORONI, G. P. c19 N72-20991
FORSYTH, P. A. c13 N72-21132
c07 N72-21139
FORTMANN, T. E. c07 N72-21120
FORTNER, L. E., JR. c20 N72-21616
FORTNEY, R. E. c29 N72-21852
FOSS, J. G. c34 N72-21987
FOX, W. T. c13 N72-21401
FRAAS, A. P. c22 N72-21655
c33 N72-21958
FRANK, C. W. c15 N72-21491
FRANK, L. A. c29 N72-21828
FRANKE, B. c31 N72-21897
FRAZER, R. K. c34 N72-21986
FRECHE, J. C. c15 N72-21485
c17 N72-21538
FREED, K. F. c26 N72-21764
FREEMAN, R. F. c13 N72-21389
FREY, D. H. c20 N72-21614
FRIANT, A. c14 N72-21439
FRIEDLANDER, F. c09 N72-21262
FRIHAGEN, J. c07 N72-21121
c07 N72-21140
FRISBIE, H. F. c14 N72-21418
FUCHS, M. c31 N72-21898
FUJITA, S. c33 N72-21949
FUNK, B. H., JR. c14 N72-21407

## G

GADZUK, J. W. c26 N72-21749
GAETANO, G. c14 N72-21432
GAHAN, J. W. c15 N72-21479
GALABURDA, M. A. c17 N72-21546
GALAN, T. M. c14 N72-21404
GALANTI, C. c08 N72-21231
GALLAHER, W. H. c31 N72-21888
GALVIN, L. V. P. c02 N72-20987
GANDIN, L. S. c20 N72-21587
GANNON, P. J. c34 N72-21988
GARDNER, J. E. c17 N72-21926
GARFEIN, A. c14 N72-21430
GARRISON, J. G. c14 N72-21911
GASPARI, G. D. c26 N72-21779
GASPERO, M. c24 N72-21683
GASSMAN, G. J. c13 N72-21123
GEE, S. W. c21 N72-21632
GERLACH, O. H. c02 N72-20992
GEYSER, L. C. c28 N72-21817
GHIGLIONE, M. c17 N72-21536
GIFFORD, E. C. c04 N72-21067
GILBERG, L. A. c02 N72-21019
GILDER, H. M. c17 N72-21545
GILES, C. A. c06 N72-21096
GLASER, Z. R. c04 N72-21071
GLASS, F. M. c14 N72-21438
GLATT, C. R. c08 N72-21229
c08 N72-21239
GLICKSMAN, M. c26 N72-21798
GLOSSER, R. c26 N72-21752
GLOWACKI, W. J. c16 N72-21509
GO, G. B. c07 N72-21162
GODDARD, D. M. c17 N72-21554
GOERTNER, J. F. c12 N72-21324
GOLD, A. J. c04 N72-21064
GOLD, H. c28 N72-21817
GOLDBERG, S. c32 N72-21912
GOLDHIRSH, J. c07 N72-21171
GOLDSTEIN, R. M. c07 N72-21118
GOOCH, T. G. c14 N72-21910
GOODSON, R. E. c15 N72-21500
GOODWIN, G. M. c15 N72-21490
GOON, W. c33 N72-21963
GOREV, K. V. c17 N72-21548
GORLOV, I. G. c33 N72-21957
GORSTEIN, M. c02 N72-20999
GOSSICK, B. R. c24 N72-21679
GOULD, D. G. c02 N72-21014
GRABBI, R. c28 N72-21820
GRADER, R. J. c30 N72-21872
GRADETSKII, V. G. c15 N72-21495
GRAEDEL, T. E. c29 N72-21834
c29 N72-21845
c29 N72-21846
GRAHAM, R. W. c12 N72-21311
GRAN, R. c19 N72-21580
GRANNEMANN, W. W. c26 N72-21804
GRANT, W. N. c26 N72-21789
GRAVES, E. B. c01 N72-20971

GRAY, J. D. c14 N72-21461
GREBENYUK, V. P. c04 N72-21051
GREEN, C. c07 N72-21187
GREEN, E. E. c15 N72-21491
GREEN, W. G. c30 N72-21857
GREENE, D. R. c20 N72-21604
GREENMAN, N. N. c30 N72-21860
GREKSKOVICH, C. D. c16 N72-21513
GRIANTI, F. c24 N72-21689
GRILLI, M. c24 N72-21689
GRITZNER, M. L. c22 N72-21654
GROESBECK, D. E. c02 N72-21001
GROOM, N. J. c30 N72-21863
GROSE, W. L. c14 N72-21424
GROSS, C. c14 N72-21422
GROSS, H. G. c30 N72-21860
GROSSE, G. c28 N72-21822
GRUEN, D. M. c03 N72-21039
GRUETTER, A. c17 N72-21544
GRUHL, W. M. c31 N72-21894
GRUZA, G. V. c20 N72-21585
GUELACHVILI, G. c14 N72-21411
GUGGENHEIM, H. J. c06 N72-21107
GUNVORDAHL, J. W. c08 N72-21221
GURNETT, D. A. c25 N72-21690
c29 N72-21828
GURSHTEYN, A. A. c30 N72-21866
GUSEV, V. N. c12 N72-21322
GUTHRIE, J. W. c04 N72-21065

## H

HADDON, D. c08 N72-21231
HAENER, J. c18 N72-21559
HAENSEL, R. c26 N72-21735
HAGAN, K. c05 N72-21086
HAGFORS, T. c07 N72-21130
HAGSTROEM, S. B. M. c26 N72-21728
HAGSTRUM, H. D. c14 N72-21747
HAGUE, D. S. c08 N72-21229
c08 N72-21239
HAGWOOD, G. J. c10 N72-21275
HAINES, R. F. c05 N72-21079
HALL, B. C. c08 N72-21203
HALL, E. R. c05 N72-21080
HALL, G. W. c02 N72-21030
HALLOCK, J. c02 N72-20999
HALPERN, S. c02 N72-21012
HAMILTON, T. c31 N72-21889
HAMILTON, W. O. c26 N72-21806
HAMMOND, P. K. c08 N72-21219
HAMPTON, G. R. c15 N72-21499
HAMROCK, B. J. c15 N72-21470
HANAK, J. J. c09 N72-21267
HANDLER, P. c26 N72-21754
HANZELY, S. c26 N72-21742
HARALSON, H. H. c15 N72-21482
HAROULES, G. G. c21 N72-21627
c21 N72-21628
HARRIOTT, W. F. c20 N72-21592
HARRIS, D. M. c07 N72-21119
HARRIS, G., JR. c11 N72-21298
HARRIS, J. F. c12 N72-21312
HARRIS, P. c21 N72-21627
HARRISON, D. R. c10 N72-21276
HARTER, E. J. c15 N72-21500
HARTMANN, G. K. c07 N72-21141
HARTUNG, R. F. c32 N72-21941
HARTZ, T. R. c07 N72-21122
HARWELL, R. J. c18 N72-21557
HASELOFF, J. c31 N72-21898
HASHIN, Z. c32 N72-21932
HASTIE, E. c12 N72-21325
HATA, T. c06 N72-21093
HATTORI, M. c20 N72-21588
HAWORTH, R. T. c13 N72-21375
HAWTHORNE, J. R. c22 N72-21659
HAYAKAWA, T. c33 N72-21949
HAYNES, J. L. c15 N72-21482
HAZEL, M. E. c14 N72-21449
HEALD, D. A. c27 N72-21812
HECHLER, F. c30 N72-21873
HECKERT, G. P. c07 N72-21191
HEDEN, P. O. c26 N72-21728
HEDIN, L. c26 N72-21730
c26 N72-21733
HEIER, W. C. c15 N72-21484
c15 N72-21486
c15 N72-21487
HEINEMANN, K. c14 N72-21421
HELLER, R. C. c14 N72-21458
HELMICK, B. W. c20 N72-21604
HELSTROM, C. W. c24 N72-21675
HELSZAJN, J. c07 N72-21164
HENDERSON, M. E. c14 N72-21433
HENDEY, N. I. c04 N72-21068
HENDRICKS, H. D. c06 N72-21103
HENNECKE, D. K. c33 N72-21959
HENRY, R. E. c12 N72-21311
HENRY, R. M. c20 N72-21589
HENSEL, J. C. c26 N72-21756
HENTHORNE, M. c17 N72-21923
HEREWARD, H. G. c24 N72-21681
HERSHKOWITZ, R. M. c21 N72-21629
HERZOG, E. c32 N72-21924
HESS, S. L. c20 N72-21605
HESSE, G. c04 N72-21042
HEWKA, P. V. c14 N72-21440
HIGGINS, L. O. c21 N72-21626
HIGGINS, R. J. c26 N72-21788
HILDEBRAND, R. R. c02 N72-20985
HILL, R. W. c30 N72-21872
HILZ, R. c04 N72-21063
HINMAN, E. J. c34 N72-21983
HIRSCHEL, E. H. c12 N72-21317
HIRTZ, P. c26 N72-21802
HISLOP, J. S. c13 N72-21368
HITCHMAN, M. J. c04 N72-21052
HIXSON, W. C. c02 N72-21016
HO, J. C. c26 N72-21762
c26 N72-21775
HOCH, G. M. c32 N72-21928
HOCHMAIR, E. S. c09 N72-21255
HODDER, D. T. c15 N72-21476
HODGES, J. C. c07 N72-21129
HOFFMAN, J. K. c07 N72-21154
HOFFMAN, R. J. c33 N72-21962
HOLDREN, R. T., III c07 N72-21117
HOLLAND, W. B. c10 N72-21278
HOLLIDAY, J. E. c26 N72-21743
HOLMER, W. c31 N72-21892
HOLMES, R. F. c06 N72-21099
HOLMSTROM, F. R. c14 N72-21449
c26 N72-21701
HOLTET, J. c07 N72-21131
HOLTMANN, H. W. c04 N72-21053
HOLTZCLAW, B. L. c07 N72-21144
HOLUB, K. c13 N72-21342
HONZAWA, T. c25 N72-21692
HOPKINS, J. B. c14 N72-21449
HOPPE, R. c26 N72-21799
HORNER, J. L. c14 N72-21447
c14 N72-21448
HORNFELDT, S. c26 N72-21795
HORTTOR, R. L. c07 N72-21118
HOVAN, M. J. c17 N72-21554
HOVEY, R. J. c05 N72-21083
HOWARD, F. S. c31 N72-21893
HOWSER, L. M. c24 N72-21677
HRUBY, R. J. c15 N72-21464
HSIA, Y. c26 N72-21784
HU, S. c26 N72-21760
HUFF, R. G. c02 N72-21001
HUFF, R. J. c07 N72-21167
HUFFMAN, F. N. c05 N72-21086
HUGHES, D. B. c14 N72-21432
HUGO, M. c32 N72-21924
HUMBERT, J. E. c04 N72-21052
HUNT, J. T. c16 N72-21505
HUSAIN-ABIDI, A. S. c23 N72-21661
c23 N72-21662
HUTCHINSON, B. G. c34 N72-21971

## I

IANNINI, A. A. c14 N72-21430
IBRMAJER, J. c13 N72-21335
IGNATJUSINA, E. N. c20 N72-21581
IKRATH, K. c07 N72-21180
ILIN, B. A. c12 N72-21322
INDENBAUM, S. V. c17 N72-21522
ING, G. c20 N72-21600
INGER, G. R. c01 N72-20975
INGRAO, H. C. c02 N72-21000
c14 N72-21451
IRWIN, J. E. c15 N72-21490
ISHEE, J. H. c08 N72-21233
ISHIMARV, A. c07 N72-21169
IVANOV, A. V. c30 N72-21865

## J

JACEY, M. J. c04 N72-21057
c04 N72-21059
JACOBY, I. c04 N72-21050
JAFFEE, R. I. c17 N72-21526
JAKOVLEVA, L. P. c20 N72-21586
JALINK, A., JR. c14 N72-21419
JAMES, T. A. c08 N72-21203
JANAK, J. F. c26 N72-21723
JASIENSKI, Z. c32 N72-21934
JASPERSON, S. c26 N72-21754
JELLETT, K. c11 N72-21301
JENA, P. c26 N72-21779
JENKINS, R. K. c06 N72-21105
JENSEN, C. A. c25 N72-21693
JESSUP, A. D. c15 N72-21477
JEX, D. W. c12 N72-21310
JEZEK, B. W. c02 N72-21013
JHERNBORG, G. c22 N72-21652
JOHANSSON, K. c17 N72-21542
c17 N72-21542
JOHNSON, C. c16 N72-21505
JOHNSON, E. J. c26 N72-21755
JOHNSON, K. G. c15 N72-21462
JOHNSON, K. H. c26 N72-21704
JOHNSON, N. c07 N72-21181
JOHNSON, R. E. c02 N72-21029
JOHNSON, S. L. c02 N72-21027
c14 N72-21456
JOHNSSON, B. c22 N72-21652
JOHNSTON, R. K. c27 N72-21813
JONES, C. W. c07 N72-21192
JONES, R. K. c04 N72-21054
JONES, R. T. c02 N72-21010
c08 N72-21229
c08 N72-21239
JORDAN, J. P. c04 N72-21041
JORTNER, J. c18 N72-21565
JORY, H. c09 N72-21262
JOSHI, S. K. c26 N72-21765
JUNKER, A. M. c04 N72-21065

## K

KAHN, H. D. c26 N72-21788
KAGAN, M. R. c05 N72-21081
KALAFUS, R. M. c21 N72-21627
KALFAYAN, S. H. c07 N72-21154
KALLERGIS, M. c28 N72-21822
KALLINS, C. c15 N72-21478
KAMM, I. O. c02 N72-21012
KANE, T. R. c21 N72-21624
KANTER, E. c08 N72-21214
KAPITANOVA, T. P. c13 N72-21353
KARAFIATH, L. L. c14 N72-21460
c32 N72-21942
KARAKULKO, W. c31 N72-21887
KARIOTIS, A. H. c14 N72-21420
KARNIK, V. c13 N72-21337
KARP, S. S. c11 N72-21305
KARSANOV, G. V. c17 N72-21522
KATOLICHENKO, V. A. c15 N72-21492
KATZ, A. H. c07 N72-21151
KATZ, S. c12 N72-21325
KAUFMAN, J. G. c17 N72-21920
KAUFMAN, L. A. c08 N72-21223
c18 N72-21555
KAVADAS, A. c07 N72-21133
KAVLIE, D. c32 N72-21936
KAWAMURA, R. c13 N72-21359
KAYE, S. c27 N72-21812
KAZNACEEVA, V. D. c20 N72-21582
KEENER, E. R. c02 N72-21005
KEITEL, G. c26 N72-21735
KELLER, J. B. c07 N72-21170
KELLY, M. C. c13 N72-21377
KEMENY, G. c26 N72-21768
KEMP, R. F. c14 N72-21457
KENDALL, D. A. c20 N72-21598
KENNARD, E. B. c26 N72-21748
c26 N72-21797
KENNEDY, B. W. c10 N72-21274
KENNEDY, E. J. c14 N72-21438
KENNEDY, R. S. c04 N72-21067
KENNEL, C. F. c13 N72-21354
c13 N72-21382
KERLEY, J. J., JR. c14 N72-21435
KERLIN, J. c20 N72-21606
c20 N72-21610
c20 N72-21611
c20 N72-21612
c20 N72-21613
KERNS, G. E. c14 N72-21917
KERWIN, W. J. c09 N72-21245
KESTELMAN, N. Y. c18 N72-21562
KETCHAM, S. J. c32 N72-21912
KETTERSON, J. B. c26 N72-21795
KEY, C. F. c18 N72-21557
KHAZANOVA, T. P. c17 N72-21522
KIM, B. S. c17 N72-21550
KIMBALL, R. B. c15 N72-21476
KIMBALL, S. J. c20 N72-21614
KINARD, W. H. c15 N72-21472
KING, D. c09 N72-21262
KING, O. C. c07 N72-21189
KINSLEY, O. V. c07 N72-21183
KIPARISOV, S. S. c17 N72-21518
KIREEV, V. I. c12 N72-21322
KIRK, J. H. c04 N72-21066
KISS, G. c16 N72-21506
KLARK, G. B. c17 N72-21530
KLATT, D. c07 N72-21187
KLEIN, K. E. c04 N72-21053
KLEIN, M. M. c07 N72-21177
KLEMME, D. E. c04 N72-21068
KLIMA, K. c13 N72-21341
KLOC, I. c14 N72-21406
KLUEH, R. L. c06 N72-21108
KLUSEK, F. c07 N72-21171
KMETKO, E. A. c26 N72-21712
KNEPP, D. L. c07 N72-21171
KNIGHT, J. c21 N72-21640
KNOEBEL, H. W. c08 N72-21240
KOCH, M. c04 N72-21056
KOCZELA, L. J. c08 N72-21206
KODIS, R. c02 N72-20999
KOELBL, F. c06 N72-21091
KOENIGSBERG, W. D. c31 N72-21899
KOEPPEN, S. c26 N72-21754
KOESTLIN, H. c18 N72-21558

KOHN, W. c26 N72-21759
KOLBENHEYER, T. c13 N72-21331
KOLTSOVA, A. P. c17 N72-21514
KONDATEN, K. Y. c30 N72-21875
KONONKOVA, G. E. c13 N72-21363
KONOPIKHIN, A. A. c30 N72-21866
KOPELMAN, R. c26 N72-21732
KOSKENNIEMI, K. c14 N72-21445
KOSKIMAKI, D. c26 N72-21790
c26 N72-21797
KOSMIDER, S. c04 N72-21045
KOVATCH, G. c34 N72-21977
KOYAMA, R. Y. c26 N72-21721
KRAEMER, W. c22 N72-21652
KRAFT, G. A. c28 N72-21816
KRAHE, P. R. c32 N72-21929
KRATZER, R. c15 N72-21494
KREITMAN, M. c03 N72-21037
KREMER, H. c33 N72-21951
KRESS, K. A. c26 N72-21727
KRIGHMAR, S. I. c14 N72-21404
KROEMER, K. H. E. c05 N72-21089
KROKLIN, O. N. c25 N72-21698
KRONE, H. V. c08 N72-21240
KRUPINA, T. N. c04 N72-21046
KRUPNICK, A. C. c18 N72-21557
KRUPP, W. E. c32 N72-21928
KRYNDIN, A. N. c20 N72-21583
c20 N72-21584
KRYUKOV, P. G. c25 N72-21698
KUDVA, P. c19 N72-21574
KUGLIN, C. c09 N72-21262
KULKE, B. c21 N72-21628
KUMARI, D. c13 N72-21350
KUNZ, C. c26 N72-21735
KUNZE, J. F. c22 N72-21645
KURBATOV, V. L. c18 N72-21519
KUSHNER, H. J. c19 N72-21568
KUZMINA, Y. K. c17 N72-21518
KWON, K. C. c33 N72-21960
KYLE, M. L. c03 N72-21039

## L

LABUDDE, R. A. c06 N72-21095
LADD, D. M. c13 N72-21398
LANDER, J. J. c03 N72-21040
LANGE-HESSE, G. c13 N72-21128
LANGLADE, R. c02 N72-20982
LANGSTON, E. D. c05 N72-21078
LANZEROTTI, L. J. c29 N72-21832
c29 N72-21833
c29 N72-21834
c29 N72-21835
c29 N72-21836
c29 N72-21837
c29 N72-21838
c29 N72-21839
c29 N72-21840
c29 N72-21841
c29 N72-21842
c29 N72-21843
c29 N72-21844
c29 N72-21845
c29 N72-21846
c03 N72-21847
c29 N72-21848
c29 N72-21855
LAPEYRE, G. J. c26 N72-21727
LAPSKER, I. A. c18 N72-21562
LARIKOV, L. N. c17 N72-21516
LARSON, R. V. c16 N72-21510
LARUSSA, F. J. c21 N72-21627
LATIMER, T. W. c03 N72-21039
LATIPOV, K. S. c14 N72-21455
LAUE, H. H. c09 N72-21252
LAUFER, J. C. c26 N72-21732
LAUTZENHEISER, M. c34 N72-21982
LAVERNE, M. E. c33 N72-21958
LAVRUKHINA, A. K. c30 N72-21862
LAWRENCE, G. G. c14 N72-21447
LAWSON, D. C. c07 N72-21191
LAX, B. c26 N72-21757
LAYTON, G. P., JR. c02 N72-20986
LEADABRAND, R. L. c07 N72-21129
LEBAILLY, M. c26 N72-21802
LEBEDEV, K. B. c17 N72-21535
LECLERC, P. c26 N72-21802
LEDINEGG, E. c07 N72-21166
LEE, C. W. c12 N72-21323
LEE, H. T. c18 N72-21564
LEE, R. D. c07 N72-21161
LEE, S. Y. c23 N72-21663
LEFRANCOIS, J. c24 N72-21680
LEHMANN, W. c32 N72-21922
LEHR, H. F. c14 N72-21446
LEMEUNE, G. c07 N72-21180
LEON, H. A. c04 N72-21052
LEONARD, J. M. c04 N72-21068
LEONDES, C. T. c08 N72-21211
c34 N72-21984
LEONTYEV, L. V. c30 N72-21864
LEQUEUX, J. c29 N72-21853
LEROI, G. E. c23 N72-21667
LESLIE, F. R. c21 N72-21635
LEVI, D. W. c18 N72-21564
LEVINE, H. c12 N72-21327
LEVINE, M. W. c16 N72-21502
LEWIS, D. c17 N72-21542
LEWIS, F. c20 N72-21604
LIBBY, W. F. c25 N72-21693
LIBENSON, G. A. c17 N72-21518
LICKLIDER, J. C. R. c07 N72-21187
LIE, H. P. c29 N72-21832
LIEFELD, R. J. c26 N72-21742
LIFSITZ, J. R. c02 N72-21000
c14 N72-21451
LIGHT, W. c21 N72-21640
LIN, J. C. c07 N72-21169
LINDEMUTH, I. R. c25 N72-21695
LINDNER, R. c04 N72-21042
LINDSAY, G. M. D. c26 N72-21740
LINDVALL, T. c20 N72-21598
LINK, M. c32 N72-21935
LIPKIS, R. S. c09 N72-21265
LISAGOR, W. B. c17 N72-21926
LISTER, J. L. c06 N72-21105
LISZKA, L. c07 N72-21137
c14 N72-21445
c23 N72-21665
LITTLE, R. E. c15 N72-21471
LLOYD, A. J. c04 N72-21072
LOCKHART, B. J. c18 N72-21556
LOMACRY, O. c32 N72-21943
LOMAX, J. B. c07 N72-21143
LONG, R. c16 N72-21512
LONGWORTH, J. P. c08 N72-21228
LOWN, E. C. c11 N72-21306
LOWREY, D. L. c05 N72-21078
LUEDERS, G. c19 N72-21573
c19 N72-21574
LUKAS, G. c05 N72-21090
LUKASHENKO, E. Y. c18 N72-21519
LUKIYANOV, L. Y. c20 N72-21593
LUNDE, L. c22 N72-21650
LUNDQVIST, B. I. c26 N72-21718
c26 N72-21730
LUNDQVIST, S. c26 N72-21730
LUSANNA, L. c24 N72-21688
LUSE, J. D. c07 N72-21191
LUSIGNOLI, M. c24 N72-21687
LUTZ, A. M. c04 N72-21070
LYDEN, C. c26 N72-21718
LYLE, R. G. c04 N72-21047
c04 N72-21048
LYNDEN-BELL, D. c29 N72-21854
LYON, G. F. c13 N72-21132
c07 N72-21139
LYON, R. J. P. c13 N72-21356
LYON, W. E. c14 N72-21409
LYONS, L. R. c13 N72-21382
LYS, X. c33 N72-21948
LYSOV, B. S. c15 N72-21521
LYTTON, J. L. c17 N72-21539

## M

MACLENNAN, C. G. c29 N72-21841
c29 N72-21846
MADSEN, R. F. c20 N72-21614
MAELAND, A. J. c26 N72-21786
MAERKER, R. E. c22 N72-21654
MAGEE, J. c02 N72-21028
MAHAN, G. D. c26 N72-21731
MAHANTI, S. D. c26 N72-21779
MAHEFKEY, E. T., JR. c03 N72-21037
MAHER, A. J. c08 N72-21216
MAIDEN, D. L. c14 N72-21417
MAILLARD, J. c14 N72-21411
MAILLOUX, R. J. c07 N72-21179
MAKHONKO, K. P. c13 N72-21370
MAKOFSKI, R. A. c34 N72-21983
MAKOS, W. S. c08 N72-21218
MAMIYA, T. c26 N72-21772
MANCUSO, R. L. c20 N72-21601
MANIAR, N. M. c02 N72-21012
MANNING, F. W. c14 N72-21438
MANNING, J. C. c20 N72-21589
MANOLI, R. c14 N72-21431
MANUKHIN, A. V. c18 N72-21520
MAPOTHER, D. E. c26 N72-21782
MARCHUK, G. S. c18 N72-21562
MARCUS, H. L. c14 N72-21916
MARGOSIAN, P. M. c28 N72-21821
MARKOWITZ, J. c31 N72-21892
MARTIN, F. H. c08 N72-21204
MARTIN, F. L. c13 N72-21393
MARTIN, F. W. c01 N72-20974
MARTYNENKO, A. I. c13 N72-21402
MARUSHAR, J. B. c34 N72-21984
MASUDA, Y. c26 N72-21772
MATHER, R. A. c07 N72-21144
MATSUMOTO, O. c06 N72-21092
MATTAUCH, R. J. c14 N72-21422
MATTEOLI, L. c17 N72-21930
MATTESON, T. T. c34 N72-21989
MATTHEWS, B. J. c14 N72-21457
MATTHEWS, F. R., JR. c02 N72-21004
MATTHYS, V. J. c30 N72-21857
MAURER, R. c14 N72-21446
MAYNARD, N. C. c07 N72-21131
MCABEE, E. c18 N72-21564
MCALISTER, A. J. c26 N72-21739
c26 N72-21780
MCCALLUM, J. c03 N72-21036
MCCORMAC, B. M. c13 N72-21384
c13 N72-21388
MCDONIE, A. F. c23 N72-21672
MCDOWELL, R. B. c34 N72-21983
MCELROY, C. E. c02 N72-20979
MCGINNIS, R. F. c31 N72-21886
MCGREGOR, D. M. c02 N72-21014
c22 N72-21654
MCHENRY, R. E. c17 N72-21541
MCHENRY, T. F. c14 N72-21408
MCINTYRE, P. c32 N72-21906
c32 N72-21913
MCNALLY, W. D. c01 N72-20969
MCNAMARA, A. G. c13 N72-21127
MCWILLIAMS, I. c02 N72-20999
MEDEIROS, M. F. c21 N72-21630
MEERWALD, E. c22 N72-21649
MEGRAIL, J. L. c01 N72-20970
MEIJER, P. H. E. c26 N72-21750
MELEKHIN, V. F. c18 N72-21520
MENDOZA, B. A. c07 N72-21191
MENICHELLI, V. J. c11 N72-21281
MENKES, J. c11 N72-21290
MENON, S. c22 N72-21652
MERRIMAN, S. H. c06 N72-21096
MESSIER, A. A. c04 N72-21059
MEYER, A. c26 N72-21778
MEYER, K. A. c12 N72-21319
MICHEL, G. c14 N72-21411
MIELE, A. c19 N72-21575
c19 N72-21576
MIKHAYLOV, V. F. c07 N72-21158
MILEK, J. T. c09 N72-21269
MILEKHIN, E. S. c32 N72-21945
MILLER, G. L. c29 N72-21832
MILLER, W. J. c05 N72-21084
MILLMAN, G. H. c07 N72-21152
MINDLIN, R. D. c26 N72-21803
MINER, R. V., JR. c17 N72-21527
MINKIEWICZ, V. J. c06 N72-21106
MINKOFF, R. T. c21 N72-21628
MINOR, M. M. c14 N72-21442
MINOTT, P. O. c31 N72-21890
MOEDE, L. W. c08 N72-21200
MOELLER, H. G. c07 N72-21142
MOKRY, M. c11 N72-21307
MOLDOFSKY, P. J. c14 N72-21440
MOLLET, R. E. c09 N72-21271
MONITA, C. M. c27 N72-21813
MONNIER, A. c17 N72-21543
MONTALENTI, U. c11 N72-21292
MONTEITH, J. H. c14 N72-21417
MONTGOMERY, D. C. c25 N72-21690
MONTGOMERY, J. W. c30 N72-21876
MONTGOMERY, M. D. c29 N72-21835
MONTI, R. c28 N72-21819
MOORE, L. D. c21 N72-21625
MOORE, W. A. c15 N72-21473
MORAN, J. P. c12 N72-21323
MORE, R. M. c26 N72-21766
MORGAN, R. P. c34 N72-21968
MORONEY, W. F. c04 N72-21067
MORRIS, D. E. c06 N72-21101
MORRISON, C. A. c06 N72-21112
MOSELEY, A. E. c19 N72-21576
MOSELEY, P. E. c19 N72-21575
MOTOVILOVETS, I. A. c33 N72-21961
MOUTOU, P. C. c26 N72-21801
MPONTSIKARIS, P. c21 N72-21626
MUELLER, F. M. c26 N72-21797
MUELLER, K. E. c02 N72-21013
MUELLER, R. c04 N72-21042
MUKHITDINOV, L. A. c26 N72-21699
MULHERIN, J. H. c32 N72-21915
MULHERN, J. E., JR. c07 N72-21119
MUMMA, M. J. c24 N72-21676
MUNDY, J. N. c03 N72-21039
MUNSON, J. c07 N72-21187
MURPHY, S. R. c13 N72-21383
MURRAY, R. G. c07 N72-21168
MUSABAEV, B. A. c14 N72-21455
MUTH, E. J. c15 N72-21498
MYALL, J. O. c12 N72-21318
MYNATT, F. R. c22 N72-21654

## N

NAGHDI, P. M. c06 N72-21114
c32 N72-21937
NAIDITCH, S. c15 N72-21466
NAKANISHI, S. c28 N72-21821
NARENDRA, K. S. c19 N72-21573
c19 N72-21574
NAUMANN, E. C. c10 N72-21275
NAUMANN, R. J. c12 N72-21310
NEALY, J. E. c14 N72-21424
NEDDERMEYER, H. c26 N72-21741

NEILAND, V. Y. c12 N72-21322
NELSON, H. G. c17 N72-21537
NENE, V. D. c30 N72-21863
NEU, C. E. c32 N72-21912
NEUBERT, V. H. c32 N72-21946
NEWBOLD, P. M. c08 N72-21203
NEWELL, A. c07 N72-21187
NEWFELL, A. T. c14 N72-21449
NEWMAN, B. J. c08 N72-21242
NEYBON, R. c14 N72-21425
NIKANOROV, E. c13 N72-21385
NIKITINA, E. A. c13 N72-21363
NIKOLSKII, A. A. c12 N72-21322
NILSSON, P. O. c26 N72-21770
NISSIM, E. c02 N72-21009
NIVEN, J. I. c02 N72-21016
NOBLE, L. c23 N72-21666
NOEL, B. W. c08 N72-21230
c16 N72-21507
NORICK, N. X. c14 N72-21458
NORRIS, C. c26 N72-21728
NOVAK, S. R. c14 N72-21905
NOVIKOV, I. I. c18 N72-21523
c17 N72-21547
NOWATZKI, E. A. c14 N72-21460

O

OAKLEY, W. S. c09 N72-21263
ODONNELL, P. M. c06 N72-21098
OEDING, R. G. c33 N72-21962
OELBERMANN, E. J., JR. c29 N72-21837
OFFEW, H. W. c06 N72-21116
OFSEVIT, D. S. c14 N72-21447
OGLESBY, J. J. c32 N72-21943
OGRODNIK, R. F. c23 N72-21668
OKKES, R. W. c07 N72-21294
OLESEN, J. K. c07 N72-21148
OLINER, A. A. c23 N72-21673
OLIVIERI, E. c24 N72-21685
OLSEN, J. L. c26 N72-21787
OLSSON, S. c14 N72-21445
c23 N72-21665
ORHAUG, T. c07 N72-21163
ORNER, G. M. c05 N72-21082
OSTROFF, J. c15 N72-21478
OSULLIVAN, W. J. c26 N72-21711
OZGO, Z. c26 N72-21807

P

PADAWER, G. E. c15 N72-21493
PALATUCCI, G. c07 N72-21176
PALMER, W. T. c08 N72-21219
PALMIERI, T. M. c30 N72-21872
PALMY, C. c26 N72-21787
PANT, M. M. c26 N72-21765
PANTANO, P. J. c21 N72-21627
PAOLUZI, L. c24 N72-21689
PAPE, R. c15 N72-21497
PARISEAU, W. G. c30 N72-21877
PARKER, W. G. c22 N72-21647
PARKINS, R. N. c14 N72-21904
PARSONS, B. J. c26 N72-21753
PARSONS, T. W. c07 N72-21182
PARZEN, G. c11 N72-21301
PASKERT, P. F. c20 N72-21601
PATTERSON, R. L. c10 N72-21279
PATTERSON, W. J. c06 N72-21101
PAVLOV, Y. A. c18 N72-21520
PEARCE, D. C. c21 N72-21638
PEARSON, J. R. A. c12 N72-21308
PEARSON, K. L. c08 N72-21218
PEC, K. c13 N72-21341
PEDERSON, N. F. c15 N72-21496
PELAGATTI, C. c02 N72-20978
PEPE, J. T. c08 N72-21205
PERONA, J. J. c22 N72-21648
PERRY, R. M. c13 N72-21394
PERSYK, D. E. c23 N72-21672
PETERS, W. R. c05 N72-21087
PETROFF, I. c26 N72-21709
PETROV, A. A. c16 N72-21501
PFAU, E. L. c07 N72-21189
PFEIFER, G. R. c15 N72-21494
PHELPS, A. D. R. c29 N72-21124
PHELPS, E. H. c32 N72-21925
PHLIEGER, G. A., JR. c09 N72-21250
PICHA, J. c13 N72-21330
PICK, M. c13 N72-21332
c13 N72-21344
c13 N72-21345
PIERCE, E. T. c13 N72-21392
PIKAND, L. I. c13 N72-21385
PIKE, C. P. c13 N72-21125
PILEGGI, P. T. c15 N72-21479
PILLER, H. c26 N72-21753
PINARD-LEGRY, G. c17 N72-21543
PINNEY, L. R. c04 N72-21060
PIRKLE, J. C. c34 N72-21986
PISACANE, V. L. c07 N72-21174
PLAKAS, C. J. c15 N72-21465
PLANK, G. E. c14 N72-21447
PLANTE, G. c17 N72-21543
PLUMMER, E. W. c26 N72-21749
POBORCHAYA, L. V. c13 N72-21363
POETKER, J. J. c07 N72-21196
POLLOCK, G. E. c14 N72-21433
POPOVA, Z. V. c30 N72-21867
POPOVICH, V. D. c30 N72-21868
PORTNYAGIN, M. A. c13 N72-21376
POUQUET, M. J. c13 N72-21360
POVICH, V. D. c30 N72-21867
POWELL, A. H. c15 N72-21479
POWER, F. W. c13 N72-21371
POWER, J. L. c22 N72-21644
PRASAD, A. c12 N72-21321
PRATT, R. H. c24 N72-21678
PRAUS, O. c13 N72-21348
PRERAU, D. S. c14 N72-21450
PRESNYAK, A. c34 N72-21966
PREST, A. H. c32 N72-21906
PRICE, C. F. c31 N72-21899
PRICE, C. P., III c28 N72-21826
PRICE, J. M. c12 N72-21312
PRIEST, A. H. c32 N72-21913
PRITCHARD, E. B. c14 N72-21416
PROCTOR, A. H. c08 N72-21241
PRONIN, A. A. c30 N72-21867
c30 N72-21868
PROVOST, J. R. c04 N72-21067
PUKHOVSKII, E. P. c17 N72-21548

Q

QUAINT, G. W. c11 N72-21306
QUATINETZ, M. c17 N72-21533

R

RANKOV, E. J. c20 N72-21585
RAO, G. L. c13 N72-21365
RAO, P. B. c12 N72-21328
RAPP, R. R. c20 N72-21602
RAQUET, C. A. c33 N72-21952
RASK, D. R. c14 N72-21426
RASQUIN, J. R. c15 N72-21481
RAUDSEPS, J. G. c14 N72-21450
REBOLLO, M. R. c14 N72-21459
REDDY, R. c07 N72-21187
REDMOND, P. J. c25 N72-21697
REED, W. c05 N72-21078
REES, M. H. c13 N72-21354
REINGOLD, I. c09 N72-21270
REINHARDT, C. G. c05 N72-21074
REINOEHL, J. E. c17 N72-21927
RENAUDIE, J. F. c02 N72-20984
REPLOGLE, C. R. c04 N72-21065
REY-CORUAIS, B. c14 N72-21425
REYNOLDS, L. H., II c23 N72-21669
REYNOLDS, T. W. c28 N72-21815
RHYNE, R. H. c20 N72-21589
RICHARDSON, N. N. c20 N72-21614
RICHARDSON, P. C. c04 N72-21061
RICHMOND, D. R. c04 N72-21054
RICHTER, W. J., JR. c07 N72-21189
RINDNER, W. c14 N72-21430
RITEA, H. B. c07 N72-21184
c07 N72-21185
ROBBINS, M. F. c29 N72-21840
ROBERTSON, C. F. c02 N72-21017
ROBERTSON, S. c32 N72-21939
ROBINSON, R. E. c14 N72-21412
c14 N72-21428
ROCHELLE, J. M. c14 N72-21438
RODE, O. D. c30 N72-21865
RODIONOV, E. M. c14 N72-21437
RODRICK, T. L. c08 N72-21226
ROESSLER, F. c13 N72-21373
ROGERS, A. F. c04 N72-21055
ROGERS, D. G. c20 N72-21616
ROLLER, R. F. c09 N72-21254
ROOKE, G. A. c26 N72-21737
ROSCOE, S. N. c02 N72-21027
c14 N72-21456
ROSE, R. B. c07 N72-21175
ROSENBERG, N. W. c07 N72-21177
ROSENTHAL, L. A. c11 N72-21281
ROSENWASSER, S. N. c17 N72-21554
ROSITANO, S. A. c05 N72-21079
ROSS, W. D., JR. c15 N72-21468
ROSSER, R. W. c06 N72-21102
ROTH, E. A. c30 N72-21874
ROTH, P. c12 N72-21315
ROWELL, J. M. c26 N72-21781
ROWLAND, J. R. c20 N72-21622
RUBINGER, B. c21 N72-21627
RUBINSTEIN, N. c34 N72-21986
c34 N72-21986
c03 N72-21039
RUBISCHKO, R. c17 N72-21531
RUDENKO, V. N. c07 N72-21159
RUHNKE, L. H. c33 N72-21954
RUMMEL, W. D. c04 N72-21044
RYBAKOV, B. K. c13 N72-21366
RYDELL, H. S. c20 N72-21603
RYZNAR, E.

S

SABROWSKY, H. c26 N72-21799
SACKS, B. H. c26 N72-21757
SAFFLE, R. E. c20 N72-21604
SAFFREN, M. M. c26 N72-21791
SAKINA, N. P. c13 N72-21353
SALLADA, R. V. c11 N72-20996
SALWIN, A. E. c14 N72-21442
SAMMONS, G. D. c27 N72-21814
SANDROCK, G. D. c17 N72-21538
SANG, P. J. M. c26 N72-21774
SANTELLI, M. L. c18 N72-21563
SANTONICO, R. c24 N72-21689
SATO, H. c29 N72-21830
SATYA, A. V. S. c26 N72-21773
SAUTTER, F. K. c17 N72-21549
SAVINO, J. M. c13 N72-21399
SAWYER, D. E. c08 N72-21198
SAWYER, R. F. c20 N72-21590
SCALIA, M. c24 N72-21685
SCHADE, C. M. c05 N72-21088
SCHAEFER, K. E. c04 N72-21057
c04 N72-21059
SCHAICH, W. L. c26 N72-21719
SCHALKOWSKY, S. c04 N72-21050
SCHALLER, N. G. c14 N72-21435
SCHAPPERT, G. T. c02 N72-20998
SCHEIMAN, J. c01 N72-20970
SCHELL, J. A. c13 N72-21358
SCHENK, L. W. c27 N72-21813
SCHER, M. P. c21 N72-21624
SCHIFF, A. J. c32 N72-21933
SCHIFFNER, K. c12 N72-21316
SCHIRBER, J. E. c26 N72-21711
SCHIRF, V. E. c26 N72-21717
SCHLAM, E. c09 N72-21270
SCHMIDT, P. H. c26 N72-21746
SCHMIDT, W. G. c27 N72-21809
SCHMITT, D. c27 N72-21810
SCHMITZ, W. c13 N72-21374
SCHOLAND, E. c33 N72-21951
SCHORN, R. A. c30 N72-21876
SCHREIBER, P. c26 N72-21735
SCHRIEFFER, J. R. c26 N72-21729
SCHULLER, F. T. c15 N72-21473
SCHWARTZ, A. N. c02 N72-21031
SCHWARTZ, H. J. c03 N72-21034
SCHWARTZ, R. F. c07 N72-21171
SCHWARZ, F. C. c09 N72-21251
c14 N72-21427
SCHWERING, F. c07 N72-21173
SCHWOB, H. P. c26 N72-21700
SCOTT, W. V. c21 N72-21625
SCULLY, J. C. c17 N72-21907
SEIBEL, R. M., III c28 N72-21826
SELDNER, K. c28 N72-21817
SELTZER, M. S. c17 N72-21526
SEMONES, D. E. c03 N72-21036
SENSATSKII, Y. V. c25 N72-21698
SERAPHIN, B. O. c26 N72-21752
SERPAN, C. Z., JR. c22 N72-21659
SERS, S. W. c13 N72-21357
SETHI, S. P. c19 N72-21572
SEVIN, J. c23 N72-21664
SEWARD, F. D. c30 N72-21872
SHAFFER, C. V. c09 N72-21245
SHAHINIAN, P. c22 N72-21659
SHAIDAKOV, V. I. c01 N72-20973
SHAMSUNDAR, N. c33 N72-21959
SHASHKINA, V. P. c30 N72-21866
SHAUGHNESSY, J. D. c30 N72-21863
SHCHELEV, M. Y. c25 N72-21698
SHEFFLER, K. D. c17 N72-21529
SHELER, J. A. c02 N72-21031
SHESTOPALOV, L. A. c14 N72-21413
SHIL'SHTEYN, S. S. c06 N72-21524
SHIMIZU, M. c26 N72-21783
SHIMOTAKE, H. c03 N72-21039
SHINGARAVA, K. B. c30 N72-21866
SHIRLEY, D. A. c26 N72-21722
c26 N72-21796
SHIVERS, J. P. c01 N72-20970
SHPILRAIN, E. E. c17 N72-21547
SHREIDER, Y. A. c34 N72-21965
SHRIVER, E. L. c25 N72-21691
SIEGEL, M. c33 N72-21963
SIEGEL, R. D. c02 N72-21017
SIKORA, P. F. c17 N72-21533
SILVER, R. H. c07 N72-21154
SIMMONDS, P. G. c15 N72-21474
SIMON, Z. c13 N72-21336
SINDLINGER, R. S. c21 N72-21222
SINGER, A. c09 N72-21266
SINGER, J. c32 N72-21947
SINGER, S. c29 N72-21835
SINGH, J. J. c24 N72-21677
SINGH, J. P. c34 N72-21968
SINNETT, E. J. c02 N72-20987
SIRKIS, J. A. c05 N72-21077
SITNIK, M. D. c15 N72-21492
SIZOV, E. A. c17 N72-21514
SJOESTROEM, R. c26 N72-21733
SKRIVSETH, K. A. c07 N72-21178
SKVORTSOVA, G. V. c16 N72-21501

SLANSKY, C. M. c22 N72-21653
c22 N72-21658
SLAUGHTER, G. M. c15 N72-21490
SLAVIN, F. c33 N72-21963
SLEEPER, H. P., JR. c30 N72-21870
SLOCUM, G. K. c08 N72-21221
SLUHAEV, V. V. c12 N72-21309
SMALLEY, R. R. c11 N72-21287
SMIDT, F. A., JR. c22 N72-21659
SMITH, G. E. c02 N72-21017
SMITH, G. H. c08 N72-21212
SMITH, H. H. c22 N72-21659
SMITH, M. C. c06 N72-21097
SMITH, N. V. c26 N72-21724
SMITH, P. F. c04 N72-21056
SMITH, R. E., JR. c24 N72-21677
SMOKTII, O. I. c30 N72-21875
SMOLARZ, W. c04 N72-21045
SNODGRASS, R. C. c21 N72-21636
SNYDER, J. A. c15 N72-21475
SOBOLEV, G. L. c09 N72-21260
SODERSTRAND, M. A. c10 N72-21277
SOLTIS, C. M. c29 N72-21843
SOLTIS, D. G. c03 N72-21034
SOMENKOV, V. A. c06 N72-21524
SOMMERS, R. D. c33 N72-21952
SONGA, T. c17 N72-21930
SONNTAG, B. c26 N72-21735
SOTER, E. J. c05 N72-21076
SOUTHWARD, H. D. c16 N72-21507
SPADY, A. A., JR. c05 N72-21075
SPAIN, I. L. c18 N72-21785
SPARROW, E. M. c33 N72-21959
SPENCER, J. c34 N72-21985
SPERANSKAYA, A. A. c13 N72-21363
SPEZIA, E. c02 N72-21016
SPICER, W. E. c26 N72-21720
c26 N72-21721
SPILLANTINI, P. c24 N72-21689
SPITZER, C. D. c14 N72-21423
SPIVAKOV, A. S. c17 N72-21531
SPRAGUE, J. A. c22 N72-21659
SPROWLS, D. O. c14 N72-21903
c17 N72-21920
SQUIER, E. D. c13 N72-21391
SQUIRES, R. D. c05 N72-21084
SRIVASTAVA, Y. c24 N72-21687
STABEKIS, P. D. c04 N72-21047
STAEHLE, R. W. c14 N72-21917
STAINBACK, J. D. c14 N72-21423
STANDISH, C. J. c08 N72-21217
STARR, J. B. c14 N72-21426
STEELE, E. R. c21 N72-21631
STEELE, L. E. c22 N72-21659
STELJES, J. F. c29 N72-21849
c29 N72-21850
STEPANGNKO, V. E. c14 N72-21404
STEPHENS, J. R. c17 N72-21525
STERN, J. c28 N72-21825
c34 N72-21990
STESLICKA, M. c26 N72-21761
STEUNENBERG, R. K. c03 N72-21039
STEWART, A. T. c26 N72-21745
STEWART, W. C. c02 N72-21015
STILLE, J. K. c15 N72-21491
STITTSWORTH, D. E. c09 N72-21256
STOCKER, P. J. c14 N72-21916
STOCKS, G. M. c26 N72-21778
STOERING, J. P. c30 N72-21872
STOLL, A. M. c04 N72-21069
STONE, G. R. c27 N72-21812
STORY, A. W. c02 N72-21008
STRACH, S. c12 N72-21321
STRADAL, O. c34 N72-21971
STRAIT, S. F. c14 N72-21453
STRAND, V. c08 N72-21215
STRINGER, J. c17 N72-21526
STROUD, R. H. c04 N72-21048
STRUNKIN, V. A. c28 N72-21827
STUKEL, D. J. c26 N72-21714
SUCKLING, D. H. c22 N72-21645
SUGG, F. E. c15 N72-21467
SULLIVAN, E. M. c33 N72-21956
SULLIVAN, T. c02 N72-20999
SUMMERFIELD, M. c28 N72-21823
SUNG, H. c33 N72-21960
SUTHERLAND, R. J. c04 N72-21055
SUTTON, D. c04 N72-21062
SUZUKI, K. c26 N72-21756
SVENSSON, B. c17 N72-21542
SWANSON, R. W. c07 N72-21144
SWARTZENDRUBER, L. J. c17 N72-21540
SWEARINGEN, J. J. c05 N72-21078
SWINTH, K. L. c14 N72-21441
SWITENDICK, A. C. c26 N72-21711
c26 N72-21738
SYKES, L. R. c13 N72-21399

T

TAHIM, R. S. c07 N72-21164
TAILLON, N. V. c28 N72-20983
TAKAHASHI, T. c03 N72-21035
TAKEDA, H. c33 N72-21949
TANENBAUM, S. B. c13 N72-21361
TANG, Y. S. c22 N72-21647
TAO, T. F. c26 N72-21784
TAPPAN, D. V. c04 N72-21058
TATI, T. c29 N72-21830
TAYLOR, E. M. c04 N72-21062
TAYLOR, G. N. c07 N72-21134
TAYLOR, R. c02 N72-21028
TEGTMEIER, A. c31 N72-21897
TELYATNIKOV, L. P. c32 N72-21945
TEPERA, J. E. c23 N72-21670
TER-MKRTCHYAN, M. G. c20 N72-21593
THENARD, C. c11 N72-21302
THEUS, R. B. c14 N72-21442
THOMAS, J. O. c29 N72-21124
THOMAS, R. H. c08 N72-21207
THOMAS, R. L. c15 N72-21500
THOME, G. D. c07 N72-21136
c12 N72-21328
THOMPSON, M. O. c02 N72-20986
THOMPSON, R. L. c33 N72-21954
THOMPSON, S. P. c15 N72-21479
THORNE, R. M. c13 N72-21382
c13 N72-21403
TIZUL, A. Y. c04 N72-21046
TOLSTOY, I. c13 N72-21381
TOMAN, K. c07 N72-21146
TOOLE, P. C. c08 N72-21197
TOROK, E. J. c08 N72-21218
TORVIK, P. J. c12 N72-21326
TOURRAILLE, J. c02 N72-20982
TOUSSAINT, J. c07 N72-21295
TOWNSEND, D. P. c15 N72-21469
TOY, M. S. c06 N72-21100
TRAEGER, L. c13 N72-21336
TRAPP, J. A. c32 N72-21937
TRENT, R. L. c26 N72-21800
TRIFTSHAEUSER, W. c26 N72-21745
TRIKHUNKOV, M. F. c15 N72-21492
TRIMPI, R. L. c14 N72-21424
TRIPATHI, S. S. c19 N72-21574
TRUE, D. G. c13 N72-21395
TRUMP, P. A. c09 N72-21272
TSENG, H. K. c24 N72-21678
TSUI, S. c02 N72-21012
TUMANOV, A. N. c15 N72-21521
TUPOLEV, A. N. c02 N72-21019
TURTLE, J. P. c29 N72-21837
c29 N72-21855
TYUREKHODZHAYEVA, T. S. c17 N72-21535
TYURIN, Y. L. c25 N72-21698

U

ULILENHOET, R. c01 N72-20972
ULABY, F. T. c07 N72-21188
ULRICH, B. R. c14 N72-21431
UMANSKIY, Y. S. c06 N72-21524
UNGER, F. G. c21 N72-21222
UREUX, J. c14 N72-21444

V

VALENTINY, G. c07 N72-21299
VAMPOLA, A. L. c29 N72-21837
c29 N72-21855
VANBIBBER, L. E. c22 N72-21647
c22 N72-21656
VANEK, J. c13 N72-21338
c13 N72-21339
c13 N72-21340
VANETTEN, J. P. c08 N72-21225
VANVOORHIS, D. C. c10 N72-21280
VANZURK, R. c09 N72-21257
VARBIELLINI, G. c24 N72-21689
VAUGHAN, C. A. c31 N72-21887
VERGNAUD, J. c14 N72-21425
VESQUE, J. c24 N72-21682
VESSOT, R. F. C. c16 N72-21502
VICEK, J. c22 N72-21651
VIDEM, K. c22 N72-21650
VIELAND, L. J. c26 N72-21793
VILLEMARETTE, R. c31 N72-21887
VINOGRADOV, A. P. c30 N72-21861
VINOGRADOV, G. M. c14 N72-21437
VINOGRADOVA, L. V. c13 N72-21349
VIOLA, V. E., JR. c14 N72-21442
VISENTIN, R. c24 N72-21689
VISWANATHAN, C. R. c26 N72-21709
VOGT, F. B. c04 N72-21061
VOLFSON, A. O. c09 N72-21260
VONAREX, W. S. c13 N72-21375
VONGLAHN, U. H. c02 N72-21001
VOROBYEV, Y. A. c07 N72-21157
VYSKOCIL, P. c13 N72-21343
VYSKOCIL, V. c13 N72-21334

W

WABER, J. T. c26 N72-21748
c26 N72-21790
c26 N72-21797
WAGES, C. G. c15 N72-21482
WAGNER, J. P. c03 N72-21038
c08 N72-21242
WAGNER, R. A. c13 N72-21125
WALKER, D. c28 N72-21817
WALKER, J. W. c21 N72-21638
WALKER, R. E. c34 N72-21986
WALLACE, R. S. c34 N72-21969
WALLIS, M. c29 N72-21851
WALSH, T. M. c14 N72-21434
WALTER, R. A. c20 N72-21592
WANG, T. C. c09 N72-21265
WANG, T. G. c33 N72-21964
WARD, A. L. c15 N72-21490
WASSHAUSEN, H. c26 N72-21808
WATERS, A. L. c34 N72-21978
WATERS, W. J. c15 N72-21485
WATSON, H. E. c22 N72-21659
WATSON, L. M. c26 N72-21740
WATSON, R. E. c17 N72-21540
c26 N72-21776
WEATHERBEE, J. E. c08 N72-21202
WEBB, H. E., JR. c08 N72-21241
WEBBER, W. T. c33 N72-21962
WEBER, J. W. c08 N72-21221
WEBER, K. E. c32 N72-21928
WEI, C. T. c26 N72-21773
c26 N72-21774
WEI, R. P. c14 N72-21905
WEIHRAUCH, M. c08 N72-21221
WEINER, S. c14 N72-21427
WEISS, M. R. c07 N72-21182
WEISS, R. c13 N72-21355
WELCH, A. J. c04 N72-21061
WELLS, R. R. c34 N72-21989
WHITE, C. S. c04 N72-21054
WHITE, E. C. c02 N72-21004
WHITE, H. M. c27 N72-21811
WHITEY, C. M. c09 N72-21263
WHITLOW, J. B., JR. c28 N72-21816
WHITMARSH, C. L., JR. c22 N72-21646
WHITTEN, D. E. c15 N72-21483
WICHMANN, H. c15 N72-21494
WIECH, G. c26 N72-21744
WIERZBINSKI, S. c32 N72-21934
WILCOX, B. A. c17 N72-21526
c17 N72-21534
WILDE, D. U. c08 N72-21210
WILDMAN, R. A. c02 N72-21032
WILGUS, D. S. c08 N72-21206
WILKENS, W. c31 N72-21896
WILKES, M. c14 N72-21458
WILKINS, D. c11 N72-21300
WILLENS, R. H. c26 N72-21736
WILLIAMS, A. R. c26 N72-21723
WILLIAMS, D. P. c14 N72-21905
WILLIAMS, D. R. c13 N72-21368
WILLIAMS, L. A. c32 N72-21940
WILLIAMS, M. L. c26 N72-21739
WILLIAMS, R. W. c26 N72-21710
WILLIAMS, S. L. c13 N72-21371
WILLIAMS, T. G. c08 N72-21202
c08 N72-21208
WILLIAMSON, T. A. c26 N72-21804
WILLIGES, R. C. c14 N72-21456
WILSON, H. N. c14 N72-21438
WILSON, M. L. c17 N72-21528
WINDMILLER, L. R. c26 N72-21795
WINDSOR, M. W. c06 N72-21113
WINN, L. E. c15 N72-21489
WITZKE, W. R. c17 N72-21525
WOLD, A. c26 N72-21798
WOO, K. E. c07 N72-21155
WOOD, L. L. c25 N72-21693
WOODCOCK, R. F. c05 N72-21083
WOODS, W. c07 N72-21187
WORTMAN, D. E. c06 N72-21112
WRIGHT, J. W. c13 N72-21393
WRINKLE, W. W. c15 N72-21476
WU, Y. K. c12 N72-21320

Y

YAMAMOTO, O. c03 N72-21035
YANCHUR, V. P. c06 N72-21524
YANKO-TRINITSKII, A. A. c10 N72-21273
YATES, G. K. c29 N72-21837
c29 N72-21855
YATSKO, R. S. c21 N72-21627
YEAGER, P. R. c14 N72-21432
YELON, A. c26 N72-21789
YENNI, K. R. c05 N72-21075
YOCOM, P. N. c09 N72-21267
YOUNG, R. D. c26 N72-21749
YOUNG, W. H. c26 N72-21778
YU, J. P. c33 N72-21959
YURA, H. T. c16 N72-21508

Z

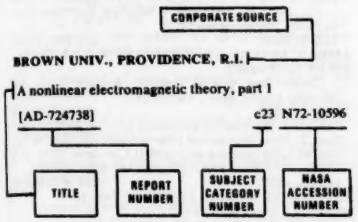
ZABSKY, J. M. c14 N72-21426
ZABLAVA, B. A. c14 N72-21415
ZAJUSZ, K. c04 N72-21045

ZAKHAROV, A. M. c18 N72-21523
ZAKHAROV, K. V. c18 N72-21560
ZAKHAROV, S. D. c25 N72-21698
ZAKHAROVA, T. P. c28 N72-21818
ZALIVADNYY, B. S. c14 N72-21414
ZAMES, G. c34 N72-21977
ZARDENKAS, R. A. c13 N72-21380
ZARETSKY, E. V. c15 N72-21469
ZBOROVSKII, I. A. c10 N72-21273
ZEALER, K. A. c14 N72-21458
ZEDLER, R. E. c14 N72-21438
ZEIDMAN, B. c14 N72-21436
ZEISSE, C. R. c26 N72-21725
ZEMLIN, G. P. c08 N72-21225
ZEZIN, R. B. c30 N72-21869
ZIMAN, J. M. c26 N72-21703
ZINN, M. H. c16 N72-21511
ZIPF, E. C. c24 N72-21676
ZOEPF, E. c26 N72-21744
ZOLOTOREVSKIY, V. S. c17 N72-21522
ZOUNKOVA, M. c13 N72-21342
ZSCHOKKE-GRANACHER, I. c26 N72-21700
ZUSMAN, A. I. c17 N72-21514

# CORPORATE SOURCE INDEX



## TYPICAL CORPORATE SOURCE INDEX LISTING




Listings in this index are arranged alphabetically by corporate source. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The subject category number indicates the subject category in the abstract section in which the citation is located. The NASA accession number denotes the number by which the citation is identified within the subject category. The titles are arranged under each corporate source in ascending accession number order.

## A

**AAI CORP., COCKEYSVILLE, MD.**
Low altitude airdrop system investigation employing inflation-aided recovery parachutes for extraction
[AD-735375] c02 N72-21013

**ADVANCED TECHNOLOGY SYSTEMS, INC., ARLINGTON, VA.**
A survey and analysis of citizens radio service
[PB-204595] c07 N72-21190

**ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT, PARIS [FRANCE].**
Flight test techniques
[AGARD-CP-85] c02 N72-20976
Radar propagation in the Arctic
[AGARD-CP-97] c07 N72-21121
Computers in the guidance and control of aerospace vehicles
[AGARDOGRAPH-158] c08 N72-21211
Atmospheric pollution by aircraft engines and fuels, a survey
[AGARD-AR-40] c20 N72-21590
Specialists Meeting on Stress Corrosion Testing Methods
[AGARD-CP-98] c32 N72-21900
Meetings, publications, membership, January 1972
[AGARD-BULL-72-1] c34 N72-21973

**AEG-TELEFUNKEN, ULM [WEST GERMANY].**
The transmitting/receiving system of the solar probe Helios
c07 N72-21162

**AEROFLEX LABS., INC., PLAINVIEW, N.Y.**
Rotary actuator
[NASA-CASE-NPO-10244] c15 N72-21478

**AEROJET NUCLEAR CO., IDAHO FALLS, IDAHO.**
Flowing gas, non-nuclear experiments on the gas core reactor
[NASA-CR-120824] c22 N72-21645

**AEROJET SOLID PROPULSION CO., SACRAMENTO, CALIF.**
The effect of solid phase reactions on the ballistic properties of propellants
[NASA-CR-111940] c27 N72-21809

**AEROPHYSICS RESEARCH CORP., BELLEVUE, WASH.**
Combat Optimization and Analysis Program [COAP]. Volume 1: Problem formulation
[AD-734755] c08 N72-21229
Combat Optimization and Analysis Program [COAP]. Volume 3: Programmer's manual
[AD-735293] c08 N72-21239

**AEROSPACE CORP., EL SEGUNDO, CALIF.**
Feasibility study of a whistler mode satellite-to-ground
[AD-736429] c07 N72-21194
A note on the high-latitude density bulge inferred from low-altitude satellite drag data
[AD-735664] c13 N72-21397
Solar photoabsorption and thermal processes in the polar thermosphere
[AD-735305] c13 N72-21400
Unified theory of SAR arc formation at the plasma pause
[AD-736431] c13 N72-21403
Atmospheric-turbulence-induced laser beamspread
[AD-735665] c16 N72-21508
POLYPAGOS user's manual
[AD-735674] c16 N72-21510
A general transport rule for variable mass dynamics
c19 N72-21570
Rapid access of solar electrons to the polar caps
[AD-736430] c29 N72-21855
Mars, Jupiter, Saturn and Uranus: 3.3 mm brightness temperatures and a search for variations with time or phase angle
[AD-728204] c30 N72-21876

**AEROSPACE ENGINEERING TEST ESTABLISHMENT, OTTAWA [ONTARIO].**
Acceptance flight testing of military aircraft
c02 N72-20987

**AEROSPACE MEDICAL RESEARCH LABS., WRIGHT-PATTERSON AFB, OHIO.**
Investigation of the primate vestibular system function through analysis of the vestibulo-ocular reflex response to various input stimuli
[AD-734545L] c04 N72-21065
Pedal operation by the seated operator
[AD-735315] c05 N72-21089

**AEROSPACE RESEARCH LABS., WRIGHT-PATTERSON AFB, OHIO.**
Theoretical electron density of states study of tetrahedrally bonded semiconductors
c26 N72-21714

**AEROSPATIALE USINES DE TOULOUSE [FRANCE].**
Methods of utilizing the results of flight tests for the study of flight performance of the Concorde supersonic transport
c02 N72-20978
Measure of performance. Methods of analysis and application to the Concorde
c02 N72-20982

**AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.**
Control experiments on active material migration in zinc electrodes
[AD-736016] c03 N72-21040

**AIR FORCE ARMAMENT LAB., EGLIN AFB, FLA.**
Mutual aerodynamic interference effects for multiple bodies by the cross-flow corrections method
[AD-735655] c01 N72-20974

**AIR FORCE CAMBRIDGE RESEARCH LABS., L. G. HANSON FIELD, MASS.**
On modelling the Arctic ionosphere
c13 N72-21123
A discussion of Arctic ionograms
c13 N72-21125
Satellite scintillations in the high latitude F-layer irregularity region
c07 N72-21138
Spatial correlation of auroral radio absorption
c07 N72-21146
HF auroral backscatter and the scintillation boundary
c07 N72-21150
Scattering of HF radio waves by a spherical electron cloud in the presence of a magnetic field
[AD-735265] c07 N72-21177
Blind spot occurrence in phased arrays: When to expect it and how to cure it
[AD-735653] c07 N72-21179
AFCRL's experimental aerial gravimetry program
[AD-735266] c13 N72-21394

**AIR FORCE EASTERN TEST RANGE, PATRICK AFB, FLA.**
AFETR instrumentation handbook
[AD-735263] c14 N72-21454

**AIR FORCE FLIGHT TEST CENTER, EDWARDS AFB, CALIF.**
An approach to stall/spin flight test of maneuvering-type aircraft
c02 N72-20979
Cruise performance testing of advanced aircraft
c02 N72-20985
Flight testing for turning performance
c02 N72-20989
US Air Force Aerospace Research Pilot School
c11 N72-20994
Experimental determination of the moments of inertia, product of inertia, and the inclination of the principal axis of conventional aircraft by the spring oscillation method
[FTC-TIM-71-1001] c02 N72-21007

**AIR FORCE GLOBAL WEATHER CENTRAL, OFFUTT AFB, NEBRASKA.**
AFGWC macro-scale update forcast model
[AD-735742] c20 N72-21606
Verification data: AFGWC macro-scale baroclinic prediction model
[AD-735737] c20 N72-21610
Verification data: AFGWC 1000 mb macro-scale prediction model
[AD-735740] c20 N72-21611
Verification data: AFGWC macro-scale cloud model
[AD-735739] c20 N72-21612
Verification data: AFGWC limited area meso scale prediction model
[AD-735738] c20 N72-21613

**AIR FORCE INST. OF TECH., WRIGHT-PATTERSON AFB, OHIO.**
A cost/decision model for the deferred procurement of an air force depot maintenance capability with a computerized application to the F-15 INS
[AD-735351] c02 N72-21029
Introduction to the electromagnetic pulse
[AD-735654] c07 N72-21183
On the attenuation of diverging waves in a porous material
[AD-735761] c12 N72-21326

**AIR FORCE ROCKET PROPULSION LAB., EDWARDS AFB, CALIF.**
Long-term storability of propellant tankage
[AD-735288] c27 N72-21811
Hot destruct test of the third-stage Athena/H solid rocket motor
[AD-735289] c28 N72-21826

**AIR FORCE SYSTEMS COMMAND, WRIGHT-PATTERSON AFB, OHIO.**
Soviet aeronautical engineering
[AD-735204] c02 N72-21019
Scientific notes of the central aerohydrodynamic institute [TsAGI]
[AD-735604] c12 N72-21322
About the anomaly of electroconductivity at the boundary of the earth's crust-mantle in the Irkutsk amphitheatre
[AD-734905] c13 N72-21376
A method for determining the coefficient of dynamic viscosity of a liquid
[AD-735640] c14 N72-21455
Multimegajoule, pulsing, explosive driven MHD feasibility study
[AD-735660] c15 N72-21497
New possibilities for the use of semiconductor diode lasers
[AD-735463] c16 N72-21506
Thermophysical properties of selected articles
[AD-735467] c17 N72-21547
Effect of alloying elements on the softening of iron base austenitic alloys
[AD-735466] c17 N72-21548
Certain properties of coatings from dry polyvinyl butyral paints SVL-21
[AD-735238] c18 N72-21562
Some features of the user of linear discriminant analysis for forecasting
[AD-735468] c20 N72-21593
Method of solving the nonlinear planetary problem of the long range forecasting of meteorological elements
[AD-736485] c20 N72-21623
Methods of navigation and guidance based on incomplete statistical data
[AD-735605] c21 N72-21637
Errors in a system for the autonomous determination of the coordinates of a moving object in the presence of dry friction
[AD-734920] c21 N72-21643
Plasma diagnostic swift laser beams
[AD-735480] c25 N72-21696

The study of plasma formed by ultrashort laser pulses
[AD-736483] c25 N72-21698
Theoretical investigation of oscillatory blade row aerodynamics under unstalled conditions
[AD-735205] c28 N72-21825
Improvement of the calculation of multistaged turbines of gas turbine engines
[AD-736489] c28 N72-21827
Concerning the possible nature of clouds in the atmosphere of Venus
[AD-734919] c30 N72-21875
Equipment for testing welded seams of thin-walled shells
[AD-735925] c32 N72-21945
Heat conductivity of plates and bodies of revolution
[AD-735582] c33 N72-21961

AIRESEARCH MFG. CO., PHOENIX, ARIZ.
Exhaust emissions test AiResearch aircraft propulsion and auxiliary power gas turbine engines
[PB-204920] c02 N72-21018

AKTIEBOLAGET ATOMENERGI, STOCKHOLM [SWEDEN].
Studies on the thermodynamics of the oxidation of metals in high-temperature milieu
[STU-68-261-U-208] c17 N72-21542

AKTIEBOLAGET ATOMENERGI, STUDSVIK [SWEDEN].
Scandinavian PCRV model project: Thermal insulation tests
[CONF-710903-6] c22 N72-21652

ALASKA UNIV., COLLEGE.
Sweep frequency backscatter radars as detectors of high latitude ionospheric phenomena
c07 N72-21147
Earth tilts in connection with crustal failure: A study in Alaska
[RLO-2229-T-4-1] c13 N72-21367

ALUMINUM CO. OF AMERICA, PITTSBURGH, PA.
Progress toward standardization of SCC test techniques by the National Association of Corrosion Engineers and the Aluminum Association
c14 N72-21903
Discussion of paper, influence of test method on stress corrosion behavior of aluminum alloys in seawater by George J. Danek
c17 N72-21920

AMERICAN INST. OF PHYSICS, NEW YORK.
An analysis of the review literature in physics
[PB-204859] c34 N72-21990

AMERICAN OPTICAL CO., SOUTHBRIDGE, MASS.
Research and development of an ocular laser protective filter
[AD-735799] c05 N72-21083

ANAGRAM CORP., SPRINGFIELD, VA.
Simulation for the assessment of tactical nuclear weapons [SATAN 2]: Operational capability description
[AD-735962] c34 N72-21982

ANALYTIC SCIENCES CORP., READING, MASS.
Adaptive control with explicit parameter identification for tactical missiles
[AD-735488] c31 N72-21899

APPLIED PHYSICS LAB., JOHNS HOPKINS UNIV., SILVER SPRING, MD.
Seawater battery experiments
[AD-735864] c03 N72-21038
The potential of the US Navy navigation satellite system in the prediction of ionospheric characteristics for high frequency sky wave tele-communications
[AD-735866] c07 N72-21174
A television data system
[AD-736150] c07 N72-21196
Meteorological applications of the bidirectional thermistor mass flow rate sensor
[AD-736152] c20 N72-21622
Space programs
[AD-735169] c21 N72-21639
The application of group theory to the calculation of the influence of an electric resonance spectrum in ruby
[AD-735814] c26 N72-21807
On the correctness of a problem with initial conditions for a partial differential equation
[AD-735507] c34 N72-21981
Control considerations for short-headway ACGV systems
[PB-205013] c34 N72-21983
Research and development programs
[AD-735869] c34 N72-21986

ARGONNE NATIONAL LAB., ILL.
Development of high-energy batteries for electric vehicles
[PB-205254] c03 N72-21039
Nondestructive assay of EBR-2 fuel pins
[ANL-7839] c22 N72-21657
Density of states and numbers of carriers from the dHvA effect
c26 N72-21795

ARIZONA STATE UNIV., TEMPE.
A research program on hyperbaric environmental effects upon primates and other animals
[AD-735117] c04 N72-21062

ARMY ELECTRONICS COMMAND, FORT MONMOUTH, N.J.
Experimental investigation of compact, ground-based high frequency antenna
[AD-735679] c07 N72-21172
Ground-loss reduction at high frequencies through the use of antenna arrays
[AD-735682] c07 N72-21173
Signal propagation at 400 kHz using an oak tree with a HEMAC as an antenna
[AD-735330] c07 N72-21178
Modelling of HF-VHF radio transmission in jungle forest covered terrains
[AD-735335] c07 N72-21180
IHAS-4 software report
[AD-765681] c08 N72-21231
The development of tactical system benchmark programs for target acquisition and surveillance applications
[AD-735327] c08 N72-21242
A comparative analysis of flat panel display technology for fixed format applications
[AD-735329] c09 N72-21270
Population inversion in a pulsed C O2-N2-He discharge
[AD-735334] c16 N72-21511
Description of a Loran-C Propagation anomaly and associated coordinate conversion problems
[AD-735680] c21 N72-21638
Selected approaches to measurement processing and implementation in Kalman filters
[AD-735331] c21 N72-21640
Processing techniques for shock resistance precision quartz crystal units
[AD-735685] c26 N72-21808

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MISS.
Design of unsurfaced soil facilities for operations of C-5A aircraft
[AD-735344] c13 N72-21398

ARMY FOREIGN SCIENCE AND TECHNOLOGY CENTER, CHARLOTTESVILLE, VA.
Aerodynamic calculation for helicopter lifting rotors in steep descent [vortex ring method]
[AD-735439] c01 N72-20973
Analysis of crossed-field travelling-wave amplifier
[AD-735435] c09 N72-21260
Production testing of the DNK-02 light distance measuring device
[AD-735235] c13 N72-21385
Automation of the map compilation process
[AD-736481] c13 N72-21402
Container transportation
[AD-735436] c15 N72-21492
Acoustic jet control systems
[AD-735234] c15 N72-21495
Determining the mechanical properties of sheet metals by using data obtained in experiments with diaphragms subjected to transversal shock
[AD-735437] c17 N72-21546
Long term strength of anisotropic composite materials under plane stress state
[AD-735434] c18 N72-21560
Antiaircraft defense herald
[AD-735425] c34 N72-21980

ARMY MATERIALS AND MECHANICS RESEARCH CENTER, WATERTOWN, MASS.
Factors influencing the strength differential of high strength steels
[AD-735314] c17 N72-21552

ARMY MEDICAL RESEARCH LAB., FORT KNOX, KY.
Visual acuity under conditions of chromatic differences without differences in luminance
[AD-734931] c04 N72-21063
The physical performance of the hyperventilator
[AD-734298] c04 N72-21072

ARMY RESEARCH OFFICE, DURHAM, N.C.
Proceedings of the 1971 Army Numerical Analysis Conference
[AD-735690] c19 N72-21579

ARMY WEAPONS COMMAND, ROCK ISLAND, ILL.
Cost estimating relationships for aircraft armament subsystem manufacturing labor cost
[AD-735495] c34 N72-21988

ARO, INC., ARNOLD AIR FORCE STATION, TENN.
Evaluation of probes for measuring static pressure in supersonic and hypersonic flows
[AD-736017] c14 N72-21461

ATMOSPHERIC SCIENCES LAB., WHITE SANDS MISSILE RANGE, N.MEX.
Lance 12805, Missile No. 2107, Round No. 139 [10December 1971]
[AD-735361] c20 N72-21595
Lance 12802, Missile No. 2130, Round No. 136 [3December 1971
[AD-735364] c20 N72-21596
Honest John 03702, Missile No. 621, Round No. 615 AML [16 December 1971]
[AD-735362] c20 N72-21597
The 12804 Lance, missile no. 2120, round no. 137
[AD-735359] c20 N72-21607
The 11604 Lance, missile no. 5129, round no. 138 RMT
[AD-735360] c20 N72-21608
The 12806 Lance, missile no. 2112, round no. 135 EST [30 November 1971]
[AD-735358] c20 N72-21617
The 12802 Lance, missile no. 2105, round no. 134 SBL [23 November 1971]
[AD-735357] c20 N72-21618
The 11601 Lance, missile no. 2171, round no. 132 RBT [12 November 1971]
[AD-735356] c20 N72-21619
The 12802 Lance, missile no. 2132, round no. 133 SBT
[AD-735355] c20 N72-21620
The 08510 Honest John, missile no. 354, round no. 613 RML [2 November 1971]
[AD-735354] c20 N72-21621

ATOMIC ENERGY OF CANADA, LTD., CHALK RIVER [ONTARIO].
Cosmic ray NM-64 neutron monitor data 19: Monthly graphs, May - August 1971
[AECL-4060] c29 N72-21849
Cosmic ray neutron and muon monitor diurnal vectors. 7: From the start of solar rotation no. 1867 to the end of solar rotation no. 1879 [17 January 1970 to 2 January 1971] and vector diagrams by solar rotation
[AECL-4059] c29 N72-21850

AUTOMATED MARINE INTERNATIONAL, NEWPORT BEACH, CALIF.
Maritime services satellite system definition study
[PB-204860] c07 N72-21191

AUTONETICS, ANAHEIM, CALIF.
An adaptive voting computer system
[NASA-CASE-MSC-13932-1] c08 N72-21206

AVCO CORP., WILMINGTON, MASS.
FM/CW HF backscatter observations of radio aurora
c07 N72-21151

## B

BARNES ENGINEERING CO., STAMFORD, CONN.
Miniature carbon dioxide sensor and methods
[NASA-CASE-MSC-13332-1] c14 N72-21408
Development of improved pyroelectric detectors. Measurements of pyroelectric material characteristics and FET characteristics
[NASA-CR-122382] c14 N72-21427

BATTELLE MEMORIAL INST., COLUMBUS, OHIO.
Lithium battery development
[AD-735269] c03 N72-21036
A program for the investigation and simulation of auroral instability mechanisms
c07 N72-21135
Dynamic response of high-frequency pressure transducers to large amplitude sinusoidal pressure oscillations
[NASA-CR-2000] c14 N72-21412
Improvement of a large-amplitude sinusoidal pressure generator for dynamic calibration of pressure transducers
[NASA-CR-120874] c14 N72-21428
Development of oxidation resistance in thoriated nickel-chromium base alloys
[NASA-CR-120880] c17 N72-21526
The role of grain size and shape in the strengthening of dispersion hardened nickel alloys
[NASA-CR-2025] c17 N72-21534
The influence of generalized order-disorder on the electron states in five classes of compound-forming binary alloy systems
c26 N72-21762
Density of states of transition metal binary alloys in the electron-to-atom ratio range 4.0 to 6.0
c26 N72-21775
The use of slow strain rate experiments in evaluating resistance to environmental cracking
c17 N72-21927

BATTELLE-NORTHWEST, RICHLAND, WASH.
Position sensitive proportional counter for neutron radiography
[BNWL-SA-3936] c14 N72-21441
Engineering utility and significance of stress corrosion cracking data
c32 N72-21901

BECTON, DICKINSON AND CO., RALEIGH, N.C.
Vacuum probe surface sampler
[NASA-CASE-LAR-10623-1] c14 N72-21415

BELL AEROSPACE CO., BUFFALO, N.Y.
The pH and potential measurements during stress corrosion of aluminum alloys
c17 N72-21909

BELL TELEPHONE LABS., INC., MURRAY HILL, N.J.
Magnetic ordering in a linear chain compound Rb-FeCl3
[BNL-16327] c06 N72-21106
Magnetic structure and Mossbauer studies of the layer antiferromagnets alpha-RbFeF4 and KFeF4
[BNL-16326] c06 N72-21107
Photoemission determination of the energy distribution of the joint density of states in copper
c26 N72-21724
The piezo soft X-ray effect
c26 N72-21736

Compton scattering from lithium and sodium
c26 N72-21746
Ion neutralization spectroscopy
c14 N72-21747
Cyclotron resonances of holes in Ge at noncentral magnetic critical points
c26 N72-21756
Tunneling measurements of superconducting quasi-particle density of states and calculation of phonon spectra
c26 N72-21781
Reduction and analysis of particle data from IMP F [Explorer 34] and IMP G [Explorer 41]
[NASA-CR-122389] c29 N72-21831
A satellite solar cosmic ray spectrometer with on-board particle indentification
c29 N72-21832
Penetration of solar protons and alphas to the geomagnetic equator
c29 N72-21833
Penetration of solar particles to ionospheric heights at low latitudes
c29 N72-21834
Penetration of solar protons into the magnetosphere and magnetotail
c29 N72-21835
Access of solar particles to synchronous altitude
c29 N72-21836
Rapid access of solar electrons to the polar caps
c29 N72-21837
Low-energy solar protons and alphas as probes of the interplanetary medium: The 28 May 1967 solar event
c29 N72-21838
Discussion of paper, "A comparison of Energetic Storm protons to halo protons"
c29 N72-21839
Solar flare alpha to proton ratio changes following interplanetary disturbances
c29 N72-21840
Relative importance of solar electrons, protons, and alphas in the November 1969 PCA event
c29 N72-21841
solar protons and alphas from the 23 May 1967 solar flares
c29 N72-21842
Interplanetary protons and alphas: 300-313, 1968
c29 N72-21843
Protons, alpha particles, and electrons resulting from the 18 November 1968 solar flare
c29 N72-21844
Interplanetary-particle associations with Type 3 solar bursts
c29 N72-21845
Enhanced abundances of low energy heavy elements in solar cosmic rays
c29 N72-21846
Solar proton radiation damage of solar cells at synchronous altitudes
c03 N72-21847
Solar flare particle radiation
c29 N72-21848

**BELLCOMM, INC., WASHINGTON, D.C.**
Equilibrium properties of the Skylab CMG rotation law
[NASA-CR-126140] c21 N72-21633
Physical correction filter for improving the optical quality of an image
[NASA-CASE-HQN-10542-1] c23 N72-21663

**BENDIX CORP., DAVENPORT, IOWA.**
Dual stage check valve
[NASA-CASE-MSC-13587] c15 N72-21483

**BENDIX CORP., KANSAS CITY, MO.**
Electrical terminations: Welded, brazed, and bonded
[BDX-613-472] c09 N72-21256

**BENDIX CORP., TETERBORO, N.J.**
Fault isolation in a digital guidance and control computer
c08 N72-21220

**BOEING CO., PHILADELPHIA, PA.**
Wind tunnel test of the conversion process of a folding tilt rotor aircraft using a semispan unpowered model. Volume 4, part 2: Blade stress analysis, bench tests, and wind tunnel model details
[AD-735733] c02 N72-21028

**BOEING CO., SEATTLE, WASH.**
Stability and control 747 flight testing
c02 N72-20977

**BOLT, BERANEK, AND NEWMAN, INC., CAMBRIDGE, MASS.**
Automated instructional monitors for complex operational tasks
[AD-736212] c05 N72-21090

**BRISTOL UNIV. [ENGLAND].**
Antarctic climate, clothing and acclimatization
[AD-734071] c04 N72-21055
The band structure problem
c26 N72-21703
Cancellation effects in the emission and absorption spectra of light metals
c26 N72-21734
On non-localization at the centre of a disordered bound band
c26 N72-21767

**BRITISH STEEL CORP., SHEFFIELD [ENGLAND].**
Current progress in the collaborative testing programme of the stress corrosion cracking [fracture mechanics] working group
c32 N72-21906
Factors influencing threshold stress intensity values and crack propagation rates during stress corrosion cracking tests of high strength steels
c32 N72-21913

**BROOKHAVEN NATIONAL LAB., UPTON, N.Y.**
Magnetic ordering in a linear chain compound RbFeCl3
[BNL-16327] c06 N72-21106
Magnetic structure and Mossbauer studies of the layer antiferromagnets alpha-RbFeF4 and KFeF4
[BNL-16326] c06 N72-21107
High field bending magnet for high energy storage rings
[BNL-16299] c11 N72-21301
Air-core and iron-core magnets and lenses with windings of finite thickness for accelerators
[BNL-TR-447] c11 N72-21303
Critical temperatures in Fe doped copper-rich Cu-Ni alloys
[BNL-16276] c17 N72-21540
Effect of nonuniform heat flux along the channel length on the critical heat flux for boiling potassium in tubes
[BNL-TR-458] c33 N72-21957

**BROWN UNIV., PROVIDENCE, R.I.**
Convergence of the discretization equations which arise in stochastic control
[NASA-CR-126037] c19 N72-21568
Optical properties and electronic density of states
c26 N72-21713
Density of electron levels for small particles
c26 N72-21760
Nonlinear optical susceptibility of semiconductors with zincblende structure
c26 N72-21792
An investigation of the properties of new semiconducting alloys and their application to luminescent devices
[NASA-CR-111997] c26 N72-21798

**BUREAU OF MINES, WASHINGTON, D.C.**
Mines Bureau says surface mining might be checked from space photographs
c13 N72-21362
Gravity flow of powder in a lunar environment. Part 2: Analysis of flow initiation
[PB-205504] c30 N72-21877

**BUREAU OF RADIOLOGICAL HEALTH, ROCKVILLE, MD.**
KWIC index to biological effects and related technology of lasers and light
[PB-205091] c04 N72-21070

## C

**CALIFORNIA INST. OF TECH., PASADENA.**
A small, fast-response probe to measure density
[AD-735954] c14 N72-21459
Counts of intense extragalactic radio
[AD-734377] c29 N72-21853
High resolution radio observations of the galactic center
[AD-734376] c29 N72-21854

**CALIFORNIA UNIV., BERKELEY.**
A class of non-isothermal viscoelastic fluids
[AD-735928] c06 N72-21114
Relationship between electrostatic turbulence and spread F
[AD-735099] c13 N72-21377
Landau level broadening in the magneto-optical density of states
c26 N72-21757
A computer program for analysis of stiffened plates under combined inplane and lateral loads
[AD-735936] c32 N72-21936
A uniqueness theorem in the theory of Cosserat surface
[AD-735927] c32 N72-21937
Non-linear analysis of plates considering geometric and material effects
[AD-735937] c32 N72-21938

**CALIFORNIA UNIV., BERKELEY. LAWRENCE RADIATION LAB.**
Electronic densities of states from X-ray photoelectron spectroscopy
c26 N72-21722
A note on the position of the gold 5d bands in AuAl2 and AuGa2
c26 N72-21796

**CALIFORNIA UNIV., LA JOLLA.**
Noncommuting observables in quantum detection and estimation theory
[NASA-CR-122364] c24 N72-21675
Local theory of disordered systems
c26 N72-21759

**CALIFORNIA UNIV., LIVERMORE. LAWRENCE RADIATION LAB.**
Consideration of a supersonic jet as a beam neutralizer
[UCRL-51089] c12 N72-21318
Tentative methods of test for the optical properties of laser rods
[UCRL-73478] c16 N72-21504
Iterative improvement approach to the numerical solution of vector Toeplitz systems
[UCRL-73495] c19 N72-21571
Alternating-direction implicit numerical solution of time dependent, two-dimensional, two fluid magnetohydrodynamic equations
[UCRL-51103] c25 N72-21695
Soft X-ray survey from the galactic center to Vela
[UCRL-51090] c30 N72-21872

**CALIFORNIA UNIV., LOS ANGELES.**
Dayside auroral oval plasma density and conductivity enhancements due to magnetosheath electron precipitation
[NASA-CR-125929] c13 N72-21354
Pitch-angle diffusion of radiation belt electrons within the plasmasphere
[AD-735934] c13 N72-21382
The kinetic and mechanical aspects of hydrogen-induced failure in metals
[NASA-TN-D-6691] c17 N72-21537
On the reflection of light from an inhomogeneous shell
[AD-736630] c23 N72-21674
Continuous plasma light source
[NASA-CASE-XNP-04167-3] c25 N72-21693
Calculation of density of states in W, Ta, and Mo
c26 N72-21709
Metal semiconductor barrier junction tunneling study of the heavily doped n-type silicon density of states function
c26 N72-21784
Attenuation of third sound in liquid helium and the stability of multiply quantized persistent circulations of a thin helium film in the Landau region
[AD-735924] c33 N72-21964
Optimization of a resource reuse system
[AD-735223] c34 N72-21984

**CALIFORNIA UNIV., SANTA BARBARA.**
Absorption and luminescence of aromatic molecules at high pressures
[AD-735163] c06 N72-21116

**CAMBRIDGE UNIV. [ENGLAND].**
High velocity liquid impact and cavitation studies
c12 N72-21314

**CARNEGIE-MELLON UNIV., PITTSBURGH, PA.**
Speech understanding systems
[AD-735758] c07 N72-21187
On the maximum principle for discrete dynamical systems with lags
[AD-735475] c19 N72-21572

**CARPENTER TECHNOLOGY CORP., READING, PA.**
Stress corrosion cracking of martensitic precipitation hardening stainless steels
c17 N72-21923

**CASE WESTERN RESERVE UNIV., CLEVELAND, OHIO.**
Effect of swirl on conical diffuser performance
[AD-735383] c12 N72-21321

**CENTER FOR NAVAL ANALYSES, ARLINGTON, VA.**
Dynamic programming approach to the optimization of naval aircraft rework and replacement policies
[AD-736094] c02 N72-21031

**CENTRAL ELECTRICITY GENERATING BOARD, BERKELEY [ENGLAND].**
MIMUSA: A FORTRAN 4 subroutine for unfolding spectra. Part 1: Theory, discussion and results
[RD/B/N-1962-PT-1] c08 N72-21228

**CENTRE D'ESSAIS EN VOL, BRETIGNY-SUR-ORGE [FRANCE].**
Some aspects of flight measurements and calibrations
c02 N72-20984

**CENTRE D'ESSAIS EN VOL, ISTRES [FRANCE].**
School of Navigation Personnel for Tests and Reception
c11 N72-20993

**CENTRE DE RECHERCHES SCIENTIFIQUES ET TECHNIQUES DE L'INDUSTRIE DES FABRICATIONS METALLIQUES, BRUSSELS [BELGIUM].**
Activities of the Centre de Recherches Scientifiques et Techniques de l'Industrie des Fabrications Metalliques
c34 N72-21976

**CENTRE NATIONAL D'ETUDES SPATIALES, BRETIGNY-SUR-ORGE [FRANCE].**
Satellite control and coordination of a control station network
c11 N72-21297

**CESKOSLOVENSKA AKADEMIE VED, BRNO.**
Gravity anomalies and the structure of the earth's crust on the territory of Czechoslavakia
c13 N72-21335

**CESKOSLOVENSKA AKADEMIE VED, PRAGUE.**
Upper Mantle project programme in Czechoslovakia 1962 - 1970: Geophysics
c13 N72-21329
Investigation of tides of the earth's crust
c13 N72-21330
On the computation of the gravity terrain correction in Czechoslavakia
c13 N72-21332

Correlation analysis of gravity anomalies and isostasy
c13 N72-21334
Crustal and upper mantle seismic activity in the European area, 2
c13 N72-21337
Amplitude curves of seismic body waves and the structure of the uppermantle
c13 N72-21338
Three dimensional seismic models of the upper mantle
c13 N72-21339
Physical parameters of rocks
c13 N72-21340
Research into theory of seismic waves
c13 N72-21341
Results of deep seismic sounding in Czechoslavakia
c13 N72-21342
Determination of the figure of the earth
c13 N72-21344
Check of Molodenskii's method on mathematical models and in test-areas
c13 N72-21345
Distribution and dynamics of the geomagnetic field based on paleomagnetic studies and analyses of secular variation: Theoretical study of geomagnetic field models
c13 N72-21347
Electric conductivity of the earth in Czechoslavakia studied by magnetotelluric and geomagnetic methods
c13 N72-21348

**CHALMERS UNIV. OF TECHNOLOGY, GOTEBORG [SWEDEN].**
Plasmon-induced structure in the optical interband absorption of free electron like metals
c26 N72-21718
Ultraviolet and X-ray photoemission from europium and barium
c26 N72-21728
Beyond the one electron approximation: Density of states for interacting electrons
c26 N72-21730
Effect of the core hole on soft X-ray emission in metals
c26 N72-21733
Density of states of AgAu, AgPd, and AgIn alloys studied by means of the photoemission technique
c26 N72-21770

**CHICAGO UNIV., ILL.**
A cluster theory of the electronic structure of disordered systems
[NASA-CR-126044] c26 N72-21764

**CHRYSLER CORP., NEW ORLEANS, LA.**
Space shuttle: Longitudinal and lateral aerodynamic characteristics of the 0.0035-scale GD/C aerospace booster [B-15B-1]
[NASA-CR-119992] c31 N72-21886
Low speed aerodynamic characteristics of the GD/C B-18E3 booster
[NASA-CR-120035] c31 N72-21888
Aerodynamic static stability characteristics, fin effectiveness, and fin location of the MSFC 33-foot pressure fed booster at high angles of attack
[NASA-CR-120040] c31 N72-21889

**COAST GUARD, WASHINGTON, D.C.**
The SAR criteria and force analysis
[AD-735408] c34 N72-21989

**COLORADO STATE UNIV., FORT COLLINS.**
Metabolic effects of artificial environments
[NASA-CR-62079] c04 N72-21041

**COLUMBIA UNIV., NEW YORK.**
High frequency vibrations of piezoelectric crystal plates
[AD-735956] c26 N72-21803

**COLUMBIA UNIV., PALISADES, N.Y.**
Models of gravity wave perturbations of the neutral upper atmosphere of the earth
[NASA-CR-2033] c13 N72-21365

**COMMISSARIAT A L'ENERGIE ATOMIQUE, GRENOBLE [FRANCE].**
Time-To-amplitude converter with a very small electronic resolving time [2.2 ps]
[CEA-N-1491] c09 N72-21257

**COMMISSARIAT A L'ENERGIE ATOMIQUE, SACLAY [FRANCE].**
Very-high-resolution nondispersive X-ray spectrometry with cooled Si[Li] detectors and optoelectron preamplifier
[CEA-CONF-1840] c14 N72-21439

**COMMUNICATIONS RESEARCH CENTRE, OTTAWA [ONTARIO].**
Morphology of radio-radar polar propagation effects
c07 N72-21122

**COMPAGNIE FRANCAISE THOMSON HOUSTON-HOTCHKISS BRANDT, PARIS.**
Study of properties of photochromatic materials and determination of their dynamical and optical characteristics
[LCR-DR-70-90/1/R] c23 N72-21664
Study of several Gunn effect operation modes
[REPT-1891] c26 N72-21801
Characterization of semiconductor materials
c26 N72-21802

**COMPUTER SCIENCES CORP., HUNTSVILLE, ALA.**
Computer system simulation and analysis
[NASA-CR-61376] c08 N72-21202

**CONNECTICUT UNIV., STORRS.**
Sonar Doppler discrimination in high noise environments
[AD-734118] c04 N72-21056
Using a small/low cost computer in an information center
[NASA-CR-126039] c08 N72-21210

**CORNELL AERONAUTICAL LAB., INC., BUFFALO, N.Y.**
A flight test investigation of direct side force control
[AD-735294] c02 N72-21030

**CORNELL UNIV., ITHACA, N.Y.**
Development of mechanically stable, thermally cyclicable point contacts for use in superconducting devices
[AD-735501] c14 N72-21453
Theory of the photoelectric effect and its relation to the band structure of metals
c26 N72-21719

**CRAIG SYSTEMS, INC., LAWRENCE, MASS.**
Design, fabrication, and testing of a shelter nomenclatured shelter, electrical equipment S-508/G
[AD-735280] c32 N72-21940

## D

**DAYTON UNIV. RESEARCH INST., OHIO.**
Kinetics of degradation of some polystyrenes and copolymers of styrene and acrylonitrile
[AD-735278] c18 N72-21561

**DAYTON UNIV., OHIO.**
An experimental investigation of cooling a high rate nickel-cadmium battery with an intercell planar heat pipe
[AD-735736] c03 N72-21037

**DENVER RESEARCH INST., COLO.**
Constant total pressure evaporation process with heat reuse by a built-in engine
[PB-204619] c33 N72-21960

**DEPARTMENT OF ENERGY, MINES AND RESOURCES, OTTAWA [ONTARIO].**
Screening tests of susceptibility to stress corrosion cracking
c14 N72-21911

**DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, BAD GODESBERG [WEST GERMANY].**
The relationship of oxygen uptake and body temperature in man in acute and severe hypoxia
[DLR-FB-71-65] c04 N72-21053

**DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, BRUNSWICK [WEST GERMANY].**
Use of aluminum alkyls as fuel or fuel additive for supersonic combustion
[DLR-MITT-71-26] c28 N72-21822
Contamination problems in space vehicles
c31 N72-21896

**DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, OBERPFAFFENHOFEN [WEST GERMANY].**
Computation of root loci using branch-following technique
[DLR-FB-71-64] c19 N72-21569

**DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, PORZ [WEST GERMANY].**
Comparison of results obtained for the problem of symmetric fluid oscillations in tanks by the finite differences technique and the finite element method
[DLR-FB-71-69] c12 N72-21316
An implicit finite-difference scheme for the calculation of hypersonic slipflow boundary layers
[DLR-FB-71-97] c12 N72-21317

**DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, STUTTGART [WEST GERMANY].**
Measurements comparing the excitation of vibrational energy of CO behind shock waves and the de-excitation of vibrational energy in expansion waves
[DLR-FB-71-62] c12 N72-21315

**DEUTSCHES ELEKTRONEN-SYNCHROTRON, HAMBURG [WEST GERMANY].**
Photoabsorption measurement of Li, Be, Na, Mg, and Al in the vicinity of K and L[ii, iii] edges
c26 N72-21735

**DORNIER-WERKE G.M.B.H., FRIEDRICHSHAFEN [WEST GERMANY].**
Flight tests of the performance of the DO-31 aircraft
c02 N72-20981

**DU PONT DE NEMOURS [E. I] AND CO., AIKEN, S.C.**
Digital data acquisition and control for a mass spectrometer
[DP-1175] c14 N72-21443

## E

**ECOLE DES MINES, PARIS [FRANCE].**
Fracture initiation and stress corrosion cracking of welded joints of alpha type titanium alloys
c32 N72-21929

**EIDGENOSSISCHE TECHNISCHE HOCHSCHULE, ZURICH [SWITZERLAND].**
The volume dependence of the electronic density of states in superconductors
c26 N72-21787

**ELECTRO-OPTICAL SYSTEMS, INC., POMONA, CALIF.**
Image Recording System, Low Light [IRSLL], phase A
[AD-735830] c23 N72-21669

**ENTWICKLUNGSRING NORD, BREMEN [WEST GERMANY].**
Possibilities for production in space
c31 N72-21897
International collaboration between ERNO and McDonnel Douglas in phase-B of the space shuttle project and preliminary results
c31 N72-21898

**ENVIRONMENTAL RESEARCH CORP., LAS VEGAS, NEV.**
Predictions of ground motion, Rio Blanco event
[NVO-1163-228] c13 N72-21369
Preliminary considerations of ground motion from a vertically oriented multiple detonation
[NVO-1163-227] c13 N72-21371

**EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH, GENEVA [SWITZERLAND].**
Coherent instability due to electrons in coasting proton beam
[CERN-71-15] c24 N72-21681

**EUROPEAN SPACE OPERATIONS CENTER, DARMSTADT [WEST GERMANY].**
Introduction to the course: System concepts in spacecraft control and operations
c11 N72-21292
Project coordination and mission support in ESOC
c11 N72-21293
Philosophy of network management and spacecraft control at ESOC
c11 N72-21298
Control of spacecraft during their life time
c07 N72-21299
Network control methods and procedures as used at ESOC
c11 N72-21300
A reliable derivation of the perturbations due to any zonal and tesseral harmonics of the geopotential for nearly-circular satellite orbits
[ESRO-SR-13] c30 N72-21873
A method and a computer program for the quick determination of a preliminary launch window for satellites with moderately-to-highly eccentric orbits
[ESRO-SR-15] c30 N72-21874

**EUROPEAN SPACE RESEARCH AND TECHNOLOGY CENTER, NOORDWIJK [NETHERLANDS].**
Study of a DC/DC converter employing a linear analog pulse width conversion in its control loop
[ESRO-TN-105-ESTEC] c09 N72-21258
Coherent detection methods for space communication
c07 N72-21294
Data generation on board satellites
c07 N72-21295

**EUROPEAN SPACE RESEARCH ORGANIZATION, PARIS [FRANCE].**
Spacecraft operations. Volume 1: Introduction, systems aspects and mission coordination
[ESRO-SP-64] c11 N72-21291
Spacecraft operations. Volume 3: Spacecraft and network control
[ESRO-SP-66] c11 N72-21296

**EXOTECH, INC., WASHINGTON, D.C.**
Contamination control through filtration of microorganisms
[NASA-CR-126035] c04 N72-21047
Contamination control by use of ethylene oxide
[NASA-CR-126034] c04 N72-21048
Planning, evaluation and analytical studies in planetary quarantine and spacecraft sterilization
[NASA-CR-126033] c04 N72-21049
Safety margins in the implementation of planetary quarantine requirements
[NASA-CR-126032] c04 N72-21050

## F

**FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C.**
The benefits of the use of shoulder harnesses in general aviation aircraft
[FAA-AM-72-3] c05 N72-21077
Effectiveness of restraint equipment in enclosed areas
[FAA-AM-72-6] c05 N72-21078

Air traffic patterns for IFR and VFR aviation, calender year 1970
[AD-735970] c21 N72-21641

**FEDERAL SCIENTIFIC CORP., NEW YORK.**
Implementation of an on-line system for automatic recognition of spoken words
[AD-735723] c07 N72-21182

**FIAT S.P.A., TURIN [ITALY].**
An integral method for extraction of Aerodynamic coefficients from flight-test data
c19 N72-20991
A contribution to stress corrosion testing of aluminum alloys
c14 N72-21918

**FLORIDA STATE UNIV., TALLAHASSEE.**
Application of phase sounder gravity wave observations to the problem of atmospheric structure
[AD-735386] c13 N72-21381

**FLORIDA UNIV., GAINESVILLE.**
Steady-state analysis of delays in open and closed networks
[AD-735348] c10 N72-21279
The production rate of a series of work stations with variable service times
[AD-735363] c15 N72-21498

**FORD MOTOR CO., DEARBORN, MICH.**
Density of states and ferromagnetism in iron
c23 N72-21708

**FRANKFORD ARSENAL, PHILADELPHIA, PA.**
Tensile ligament instability and the growth of stress corrosion cracks in a homogeneous Xn-Mg-Cu aluminum alloy
c32 N72-21915

## G

**GENERAL DYNAMICS CORP., SAN DIEGO, CALIF.**
Catalyst cartridge for carbon dioxide reduction unit
[NASA-CASE-LAR-10551-1] c06 N72-21099
Orbit-to-orbit shuttle propellant integration and handling study
[AD-735290] c27 N72-21812

**GENERAL DYNAMICS/CONVAIR, SAN DIEGO, CALIF.**
Driving lamps by induction
[NASA-CASE-MFS-21214] c09 N72-21252

**GENERAL ELECTRIC CO., CINCINNATI, OHIO.**
Fabrication and test of a space power boiler feed electromagnetic pump. Part 1: Design and manufacture of pump
[NASA-CR-1949] c15 N72-21479

**GENERAL ELECTRIC CO., PHILADELPHIA, PA.**
Pressure ramp programmer; IMBLMS Phase B4 Additional Tasks: Task 3.0 pressure ramp programmer
[NASA-CR-115508] c05 N72-21074
Research on avalanche type semiconductor radiation detectors
[NYO-3246-TA-9] c14 N72-21440

**GENERAL ELECTRIC CO., SANTA BARBARA, CALIF.**
Newsletter no. 28. Reaction rate series
[AD-735510] c06 N72-21115

**GENERAL ELECTRIC CO., SCHENECTADY, N.Y.**
Oxide ceramic laser
[AD-736223] c16 N72-21513
Excitonic effects in X-ray transitions in metals
c26 N72-21731

**GENERAL ELECTRIC CO., SYRACUSE, N.Y.**
Ionospheric refraction effect on the geometry of field-aligned ionization
c07 N72-21152

**GENERAL INSTRUMENT CORP., HICKSVILLE, N.Y.**
Nimbus 4/IRLS Balloon Interrogation Package [BIP]
[NASA-CR-122375] c14 N72-21410

**GENERAL MOTORS CORP., GOLETA, CALIF.**
Remote automatic multipurpose station
[AD-736221] c07 N72-21195

**GENERAL MOTORS RESEARCH LABS., WARREN, MICH.**
Energy band structure and density of states in tetragonal GeO2
c26 N72-21716

**GENERAL RESEARCH CORP., SANTA BARBARA, CALIF.**
Radar reflection coefficients from a plasma gradient including the effects of electron-neutral and electron-ion collisions
[AD-735146] c25 N72-21697

**GEOLOGICAL SURVEY, MENLO PARK, CALIF.**
Natural period of two-layer systems
[PB-205260] c13 N72-21396

**GEORGIA UNIV., ATHENS.**
Interactive quantal analysis
[AD-735145] c08 N72-21233
Pseudo random number generators for statistical applications
[AD-735144] c19 N72-21577

**GOODYEAR AEROSPACE CORP., AKRON, OHIO.**
Expandable floating bases
[AD-735491] c11 N72-21306
Compression test assembly to prevent buckling of small diameter specimens
[NASA-CASE-LAR-10440-1] c14 N72-21420

**GRUMMAN AEROSPACE CORP., BETHPAGE, N.Y.**
Thermal regeneration of the tensile properties of hydrolytically degraded polyimide film
[RM-538] c06 N72-21104
The effect of cone angle on penetration resistance
[AD-735788] c14 N72-21460
Time series analysis and nonlinear filtering
[AD-735787] c19 N72-21580
Study of stability and control moment gyro wobble damping of flexible, spinning space stations
[NASA-CR-115525] c31 N72-21892
On the effect of pore pressures on soil-wheel interaction
[AD-735792] c32 N72-21942

## H

**HANFORD ENGINEERING DEVELOPMENT LAB., RICHLAND, WASH.**
Preparation, characterization, and testing of austenitic stainless steel weldments
[HEDL-TME-71-118] c15 N72-21490

**HARRY DIAMOND LABS., WASHINGTON, D.C.**
Free-ion enery levels of triply ionized thulium including the spin-spin, orbit-orbit, and spin-other-orbit interactions
[AD-735319] c06 N72-21112
Short pulse RF burnout properties of crystal diode mixers in the 4-mm band
[AD-735341] c09 N72-21266
Fluerics 31. The transition from isothermal to adiabatic capacitance in cylindrical enclosures
[AD-735704] c12 N72-21325

**HARVARD UNIV., CAMBRIDGE, MASS.**
Summary of the Conference on Electronic Density of States
c26 N72-21794

**HAWAII UNIV., HONOLULU.**
Summer circulation and weather over the Korat Plateau, Thailand
[AD-735283] c20 N72-21600

**HAWKER SIDDELEY AVIATION, LTD., KINGSTON UPON THAMES [ENGLAND].**
The Harrier - Some aspects of V/STOL stability and control flight testing
c02 N72-20980

**HAZLETON LABS., FALLS CHURCH, VA.**
Firefly pump-metering system
[NASA-CASE-GSC-10218-1] c15 N72-21465

**HONEYWELL, INC., MINNEAPOLIS, MINN.**
Optimization of a fluidic temperature control device
[NASA-CR-115511] c14 N72-21426

**HOWARD UNIV., WASHINGTON, D.C.**
Effects of altitude on cellular metabolism and terminal oxidation
[AD-734933] c04 N72-21064

**HUGHES AIRCRAFT CO., CULVER CITY, CALIF.**
Guidance and control computer actuated display system techniques
c08 N72-21221
A partial list of ultrahigh frequency references containing materials/property data
[AD-735621] c09 N72-21269
Improved injector for use in high voltage isolators for liquid feed lines
[NASA-CASE-NPO-11377] c15 N72-21475

**HUGHES AIRCRAFT CO., FULLERTON, CALIF.**
Security of the TACC data base study [Description of automatic data base security techniques]
[AD-735728] c08 N72-21234
Analysis of data base security and access limitation requirements for the post 1975 automated TACC complex: Tabulation of TACC secure data
[AD-735729] c08 N72-21235
Analysis of data base security and access limitation requirements for the post 1975 automated TACC complex: Analysis of TACC secure data
[AD-735730] c08 N72-21236
Analysis of data base security and access limitation requirements for the post 1975 automated TACC complex: Tabulation of TACC secure data accesses
[AD-735731] c08 N72-21237
Analysis of data base security and access limitation requirements for the post 1975 automated TACC complex: Analysis of TACC secure data accesses
[AD-735732] c08 N72-21238

**HUMAN RESOURCES RESEARCH ORGANIZATION, ALEXANDRIA, VA.**
Systems engineering of Coast Guard aviator training
[AD-735051] c05 N72-21080

## I

**IDAHO NUCLEAR CORP., IDAHO FALLS.**
Monitoring and pretreatment analysis: Radioactive waste management
[CONF-711113-3] c22 N72-21653
Radioactive waste management in relation to the environment
[CONF-711113-2] c22 N72-21658

**IIT RESEARCH INST., CHICAGO, ILL.**
Reliability considerations in plastic encapsulated microcircuits
[AD-735500] c09 N72-21261
Excess noise in semiconductors
[AD-735944] c26 N72-21805

**ILC, INC., SUNNYVALE, CALIF.**
High power alkali vapor lamps
[AD-735951] c23 N72-21666

**ILLINOIS UNIV., URBANA.**
The frequency separated display principle, phase 3
[AD-735915] c02 N72-21027
Two computer algorithms for obtaining the periodic response of nonlinear circuits
[AD-735713] c08 N72-21232
High density optical memory
[AD-735903] c08 N72-21240
A new approach to motion relations for flight director displays
[AD-735916] c14 N72-21456
Experimental verification of the predictions of the Franz-Keldysh theory as shown by the interference of light and heavy hole contributions to the electroreflectance spectrum of germanium
c26 N72-21754
Density of states information from low temperature specific heat measurements
c26 N72-21771
Density of states from superconducting critical field measurements
c26 N72-21782

**IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON [ENGLAND].**
The polar exospheric plasma
c29 N72-21124

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Results of comparative stress corrosion tests on AlZnMgCu-alloys using different types of specimens
c32 N72-21922

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c30 N72-21871
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c34 N72-21974
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**INSTITUT D'ASTROPHYSIQUE, LIEGE [BELGIUM].**
Description of an out-of-plane inverted Wadsworth spectrograph for use onboard Centaur sounding rocket
[ESRO-SM-80] c14 N72-21444

**INSTITUT FRANCO-ALLEMAND DE RECHERCHES, ST. LOUIS [FRANCE].**
The experience of international cooperation at the ISL in the field of specific aerodynamic facilities
[ISL-4/71] c11 N72-21304
Aerosol layers in the atmosphere
[ISL-6/71] c13 N72-21373
Preliminary tests in view of the use of a differential interferometer for studying the shots of models in detonable gas mixtures
[ISL-7/70] c14 N72-21446

**INSTITUT FUER CHEMIE DER TREIBSTOFFE, BERGHAUSEN [WEST GERMANY].**
Determination of strain deformation behavior of solid propellants with high stressing velocities
[ICT-10/70] c27 N72-21810

**INSTITUTE FOR DEFENSE ANALYSES, ARLINGTON, VA.**
An estimate of the power required to eliminate trailing vortices by suction
[IDA-LOG-HQ-69-10164] c11 N72-21290

**INSTITUTE FOR TELECOMMUNICATION SCIENCES, BOULDER, COLO.**
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[NASA-CR-115515] c08 N72-21203
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**INTERNATIONAL BUSINESS MACHINES CORP., GAITHERSBURG, MD.**
Airway resistance measurement at depth
[AD-735462] c05 N72-21081
North Atlantic satellite ATC-center study
[PB-204862] c21 N72-21642
**INTERNATIONAL BUSINESS MACHINES CORP., OWEGO, N.Y.**
Federated vs integrated computer systems
c08 N72-21213
Aerospace computer word length considerations
c08 N72-21217
Computers for the guidance and control of tactical aircraft
c08 N72-21227
**INTERNATIONAL BUSINESS MACHINES CORP., YORKTOWN HEIGHTS, N.Y.**
Direct transition analysis of photoemission from palladium
c26 N72-21723
Photoemission studies of scandium, titanium, and zirconium
c26 N72-21726
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[GARP-SPEC-5] c20 N72-21591
**INTERUNIVERSITAIR REACTOR INSTITUUT, DELFT (NETHERLANDS).**
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[IRI-133-71-17] c06 N72-21111
**IOWA UNIV., IOWA CITY.**
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[AD-735369] c15 N72-21491
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[NASA-CR-125932] c29 N72-21828
**ISTITUTO DI RICERCHE BREDA S.P.A., MILAN (ITALY).**
Preliminary report on the research on the influence of thermomechanical treatments on stress corrosion cracking behaviour of AISI 4340 steel
c17 N72-21930
**ISTITUTO SPERIMENTALE DEL METALLI LEGGERI, NOVARA (ITALY).**
Preliminary results of mechanical and stress corrosion tests on plates of 7075 alloy produced by a new processing technique
c32 N72-21931
**ITT AVIONICS, NUTLEY, N.J.**
Computers for loran C/D and Omega navigation and guidance systems
c08 N72-21225
**ITT ELECTRO-PHYSICS LABS., INC., COLUMBIA, MD.**
A survey and economic assessment of the effects of air pollutants on electrical components. Volume 1: Sections 1 through 9
[PB-204183] c09 N72-21259

## J

**JET PROPULSION LAB., CALIF. INST. OF TECH., PASADENA.**
Method and apparatus for mapping planets
[NASA-CASE-NPO-11001] c07 N72-21118
A study of the frictional and stick-slip behavior of magnetic recording tapes
[NASA-CR-125930] c07 N72-21154
Multi-purpose antenna
[NASA-CASE-NPO-11264] c07 N72-21155
Current steering commutator
[NASA-CASE-NPO-10743] c08 N72-21199
Automated equipotential plotter
[NASA-CASE-NPO-11134] c09 N72-21246
Electrothermal follow display apparatus for electroexplosive device testing
[NASA-CR-125931] c11 N72-21281
Pressure transducer
[NASA-CASE-NPO-10832] c14 N72-21405
Penetrometer
[NASA-CASE-NPO-11103] c14 N72-21406
Fourier spectroscopy with a one-million-point transformation
[NASA-CR-125980] c14 N72-21411
Positioning mechanism
[NASA-CASE-NPO-10679] c15 N72-21462
Compact hydrogenator
[NASA-CASE-NPO-11682] c15 N72-21474
Improved injector for use in high voltage isolators for liquid feed lines
[NASA-CASE-NPO-11377] c15 N72-21475
Rotary actuator
[NASA-CASE-NPO-10244] c15 N72-21478
Potential independent features of crystal band structure
[NASA-CR-126045] c26 N72-21791
Mars, Jupiter, Saturn and Uranus: 3.3 mm brightness temperatures and a search for variations with time or phase angle
[AD-728204] c30 N72-21876
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c07 N72-21157
Effect of radome subjected to a heat shock upon range of a radar station
c07 N72-21158
Nonferrous metallurgy
[JPRS-55392] c17 N72-21517
Study of conditions of wetting titanium and chromium borides by iron group metals
c17 N72-21518
Vapor pressure and thermodynamic functions of magnesium chloride and potassium chloride in the titanium sponge (graphite)-chloride system
c18 N72-21519
Characteristic features of interaction of zirconium dioxide with carbon at high temperatures
c18 N72-21520
Device for obtaining mixtures of metal chloride vapors
c15 N72-21521
Study of the structure and temperature of the brittle-ductile transition of some alloys of the Cr-Ti-V-B system
c17 N72-21522
solubility of carbon in niobium
c18 N72-21523
Neutron diffraction analysis of niobium nitride Nb4N3
c06 N72-21524
Corrosive stability of metals and metal coatings under atmospheric conditions
[JPRS-55554] c17 N72-21530
Studying the true strength characteristics of several heat-resistant alloys at high temperatures
[JPRS-55556] c17 N72-21531
Strength of cast gas turbine blades under variable loads
[JPRS-55555] c28 N72-21818
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Radioactivity of the atmosphere
[AEC-TR-7268] c13 N72-21370

## K

**KANSAS UNIV., LAWRENCE.**
Project Themis: A center for remote sensing
[AD-735752] c07 N72-21188
**KENTUCKY UNIV., LEXINGTON.**
Radiation effects of germanium
[ORO-3651-10] c24 N72-21679
**KERNFORSCHUNGSZENTRUM, KARLSRUHE (WEST GERMANY).**
Pressure loss and heat transfer on smooth and rough surfaces at high temperatures and turbulent flow and their representation by universal laws
[NP-19112] c22 N72-21649
**KIRUNA GEOPHYSICAL OBSERVATORY (SWEDEN).**
Polar propagation effects on radio-astronomical and satellite transmissions
c07 N72-21137
Infrasound recording equipment at Kiruna Geophysical Observatory
[KGO-TR-71-105] c14 N72-21445
Unusual polarization effect observed on Intelsat 2F-1 Transmissions
[KGO-721] c23 N72-21665
**KOSICE UNIV. (CZECHOSLOVAKIA).**
On some methods of interpreting gravity anomalies
c13 N72-21331
**KYOTO UNIV. (JAPAN).**
Hot universe, cosmic rays of ultrahigh energy and absolute reference system
[RIFP-142] c29 N72-21830

## L

**LABORATOIRE CENTRAL DE L'ARMEMENT, ARCUEIL (FRANCE).**
Preliminaries to extracting information from dosimetric films
[NP-19129] c24 N72-21682
**LAMONT-DOHERTY GEOLOGICAL OBSERVATORY, PALISADES, N.Y.**
Long-period seismological research program
[AD-735765] c13 N72-21399
**LEEDS UNIV. (ENGLAND).**
The science committee conference on the theory of stress corrosion cracking of alloys
c17 N72-21907
**LINCOLN LAB., MASS. INST. OF TECH., LEXINGTON.**
Some properties of radar auroral echoes as observed at a frequency of 1295 MHz
c07 N72-21130
Capabilities and limitations of infrared vidicons versus infrared scanning systems
[AD-735324] c07 N72-21186
Limited electronic scanning with an offset-feed near-field Gregorian system
[AD-736029] c07 N72-21193
Limited electronic scanning with a near-field Cassegrainian-system
[AD-735661] c09 N72-21264
Millstone Hill Thomson scatter results for 1967
[AD-735727] c13 N72-21387
Optical properties of aluminum
c17 N72-21706
Variations of infrared cyclotron resonance and the density of states near the conduction band edge of InSb
c26 N72-21755
Localized states in narrow band and amorphous semiconductors
c26 N72-21763
**LITTLE (ARTHUR D.), INC., CAMBRIDGE, MASS.**
Evaluation of community odor exposure
[PB-204989] c20 N72-21598
**LITTON SYSTEMS, INC., WOODLAND HILLS, CALIF.**
Integrated inertial Doppler loran computer guidance and control
c08 N72-21224
**LOCKHEED MISSILES AND SPACE CO., HUNTSVILLE, ALA.**
Lunar targeting study: Lunar and planetary Ephemeris tapes
[NASA-CR-123595] c30 N72-21857
**LOCKHEED MISSILES AND SPACE CO., PALO ALTO, CALIF.**
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An assessment of current capability for computer analysis of shell structures
[AD-735726] c32 N72-21941
**LOCKHEED-CALIFORNIA CO., BURBANK.**
Experimental techniques used to study stress corrosion mechanisms in aircraft structural alloys
c32 N72-21928
**LOS ALAMOS SCIENTIFIC LAB., N.MEX.**
CMB-13 research on carbon and graphite
[NASA-CR-125937] c06 N72-21097
Some preliminary numerical studies of Taylor instability which include effects of material strength
[LA-4754] c12 N72-21319
HRS spectrometer system. Part 1: Concepts and design
[LA-4773-PT-1] c14 N72-21436
Calculated effects of compression upon the band structure and density of states of several metals
c26 N72-21712
**LOUISIANA STATE UNIV., BATON ROUGE.**
Wind tunnel balance system for determination of wind-induced vibrations of a rigid shuttle model in the launch configuration
[NASA-CR-115531] c11 N72-21288
Electric and magnetic shielding with superconductors
[AD-735396] c26 N72-21806
**LOVELACE FOUNDATION FOR MEDICAL EDUCATION AND RESEARCH, ALBUQUERQUE, N.MEX.**
The biodynamics of airblast
[AD-734208] c04 N72-21054
**LUDWIG-MAXIMILIANS-UNIVERSITAT, MUNICH (WEST GERMANY).**
Soft X-ray emission spectra of Al-Mg alloys Foi HC
c26 N72-21741
Soft X-ray emission spectrum and valence-band structure of silicon, and emission-band studies of germanium
c26 N72-21744

## M

**M&S COMPUTING, INC., HUNTSVILLE, ALA.**
Flight program language requiremeats. Volume 3: Appendices
[NASA-CR-123569] c08 N72-21201

**MANLABS, INC., CAMBRIDGE, MASS.**
Investigation of the fracture mechanics of boride composites
[NASA-CR-126246] c18 N72-21555
**MARQUARDT CORP., VAN NUYS, CALIF.**
Advanced ACS valve sealing surface compatibility investigation
[AD-735286] c15 N72-21494
**MARTIN MARIETTA CORP., DENVER, COLO.**
Study of critical defects in ablative heat shield systems for the space shuttle
[NASA-CR-2010] c33 N72-21954
**MARTIN MARIETTA CORP., ORLANDO, FLA.**
Temperature measurement system
[NASA-CASE-MFS-20781] c14 N72-21429
**MARYLAND UNIV., COLLEGE PARK.**
Use of position-sensitive semi-conductor detectors in the study of heavy element nuclear reactions
[MNC-3783-10] c14 N72-21442
Electronic structure of gold and its changes on alloying
c26 N72-21769
The effect of hydrostatic pressure on the Galvanomagnetic properties of graphite
c18 N72-21785
**MASSACHUSETTS INST. OF TECH., CAMBRIDGE.**
A model for process representation and synthesis
[NASA-CR-122379] c08 N72-21207
Astronomy in the region 1-0.1mm wavelengths
[NASA-CR-125936] c13 N72-21355
On the optical properties and the density of states in arsenic
c18 N72-21707
Calculation of the density of states and optical properties of PbTbTe from APW-LCAO energy bands
c26 N72-21717
The half-filled narrow energy band
c26 N72-21768
Pauli paramagnetism in metals with high densities of states
c26 N72-21777
**MAX-PLANCK-INSTITUT FUER AERONOMIE, LINDAU UBER NORTHEIM [WEST GERMANY].**
Current experimental results from a VHF-CW auroral backscatter network in Scandinavia
c13 N72-21128
Satellite scintillation between 43 deg and 66 deg northern latitude from 1964 to 1969
c07 N72-21141
Polar propagation effects on HF radars
c07 N72-21142
**MCDONNELL-DOUGLAS ASTRONAUTICS CO., HUNTINGTON BEACH, CALIF.**
Development of porous beryllium
[AD-736484] c17 N72-21554
Luminescence analysis of lunar samples returned by Apollo: Luminescence of Apollo 14 and Apollo 15 lunar samples
[NASA-CR-115512] c30 N72-21860
Space station ventilation study
[NASA-CR-123593] c31 N72-21879
Modular space station detailed preliminary design. Volume 1: Sections 1 through 4.4
[NASA-CR-123544] c31 N72-21880
Modular space station detailed preliminary design. Volume 2: Sections 4.5 through 4.8
[NASA-CR-123545] c31 N72-21881
Modular space station detailed preliminary design. Volume 3: Sections 4.9 through 6
[NASA-CR-123543] c31 N72-21882
Crew operations
[NASA-CR-121087] c31 N72-21883
Supporting research and technology
[NASA-CR-123541] c31 N72-21884
Plume contamination effects prediction: The CONTAM computer program. Program user's manual
[AD-735722] c33 N72-21962
Information management system study results. Volume 2: IMS study results appendixes
[NASA-CR-121088] c34 N72-21967
**MCDONNELL-DOUGLAS ASTRONAUTICS CO., SANTA MONICA, CALIF.**
Multiaxial behavior of ATJ-S graphite
[AD-736470] c18 N72-21565
**MCDONNELL-DOUGLAS CO., ST. LOUIS, MO.**
Utilization of oxygen difluoride for syntheses of fluoropolymers
[NASA-CASE-NPO-12061-1] c06 N72-21100
Thermally conductive polymers
[NASA-CASE-GSC-11304-1] c06 N72-21105
**MELPAR, INC., FALLS CHURCH, VA.**
Investigation of speech pattern-matching
[AD-735308] c07 N72-21189
**MESSERSCHMITT-BOELKOW-BLOHM G.M.B.H., MUNICH [WEST GERMANY].**
Aerodynamic noise reduction by controlled interference
[MBB-BB-55-71-O] c02 N72-21011
**MIAMI UNIV., FLA.**
U, Th, and Pa isotopes as indicators of geologic processes in marine environments, part 1
[ORO-3622-12-PT-1] c13 N72-21366
**MICHIGAN STATE UNIV., EAST LANSING.**
Spectroscopic studies in the far infrared
[AD-735945] c23 N72-21667
Low-temperature specific heats of hexagonal close-packed erbium-thulium alloys
c26 N72-21773
Low-temperature specific heats of face-centered cubic Ru-Rh and Rh-Pd alloys
c26 N72-21774
**MICHIGAN UNIV., ANN ARBOR.**
Wind and temperature structure in the surface layer of the atmosphere
[AD-735393] c20 N72-21603
Vibronic exition density of states in some molecular crystals
c26 N72-21732
**MICROWAVE AND ELECTRONIC SYSTEMS LTD., EDINBURGH [SCOTLAND].**
Development of a multiplexing network
[ESRO-CR-46] c07 N72-21164
**MIDWEST APPLIED SCIENCE CORP., LAFAYETTE, IND.**
Investigation of the utility of mean square approximation systems and in system response predictions
[NASA-CR-1961] c32 N72-21933
**MIDWEST RESEARCH INST., KANSAS CITY, MO.**
The mathematical analysis of fluid viscosity data
[AD-735270] c15 N72-21499
**MINNESOTA UNIV., MINNEAPOLIS.**
Power series solutions for flows of an ideal dissociating gas
[AD-735697] c12 N72-21323
Experiments on a shrouded, parallel disk system with rotation and coolant throughflow
[AD-735492] c33 N72-21959
**MITRE CORP., BEDFORD, MASS.**
Recursive navigation program description and characteristic performance, as indicated by simulation and analysis
[AD-735262] c21 N72-21636
**MOBIL RESEARCH AND DEVELOPMENT CORP., DALLAS, TEX.**
Luminescence petrography of lunar samples
[NASA-CR-115494] c30 N72-21858
**MONTANA STATE UNIV., BOZEMAN.**
Photoemission and reflectance studies of the electronic structure of molybdenum
[NASA-CR-126041] c26 N72-21727
**MOUND LAB., MIAMISBURG, OHIO.**
Stable gaseous isotope separation and purification, April - June 1971
[MLM-1828] c06 N72-21109
Stable gaseous isotope separation and purification, July - September 1971
[MLM-1861] c06 N72-21110

## N

**NAGOYA UNIV. [JAPAN].**
Observation of stable, high-Mach-number collisionless electrostatic shocks
[IPPJ-119] c25 N72-21692
Electronic density of states determined by electronic specific heat measurements
c26 N72-21772
Temperature dependence in transport phenomena and electronic density of states for transition metals
c26 N72-21783
**NATIONAL ACADEMY OF SCIENCES-NATIONAL RESEARCH COUNCIL, WASHINGTON, D.C.**
Suppression of flutter
[NASA-CASE-LAR-10682-1] c02 N72-21009
Gyrator employing field effect transistors
[NASA-CASE-MFS-21433] c09 N72-21255
Electron microscope aperture system
[NASA-CASE-ARC-10448-1] c14 N72-21421
Optical data processing using paraboloidal mirror segments
[NASA-CASE-GSC-11296-1] c23 N72-21662
**NATIONAL AERONAUTICAL ESTABLISHMENT, OTTAWA [ONTARIO].**
A flight investigation of lateral-directional handling qualities for V/STOL aircraft in low speed manoeuvring flight
[AD-735420] c02 N72-21014
Higher order theory of two dimensional subsonic wall interference in a perforated wall wind tunnel
[AD-735967] c11 N72-21307
**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. AMES RESEARCH CENTER, MOFFETT FIELD, CALIF.**
Wind-tunnel investigation of the aerodynamic characteristics of the M2-F2 lifting-body entry configuration at transonic and supersonic Mach numbers
[NASA-TM-X-2511] c02 N72-21005
Dual fuselage aircraft having yawable wing and horizontal stabilizer
[NASA-CASE-ARC-10470-1] c02 N72-21010
Automatic real-time pair feeding system for animals
[NASA-CASE-ARC-10302-1] c04 N72-21052
Visual examination apparatus
[NASA-CASE-ARC-10329-1] c05 N72-21079
Polyimide foam for thermal insulation and fire protection
[NASA-CASE-ARC-10464-1] c06 N72-21102
Intruder detection system
[NASA-CASE-ARC-10097-2] c07 N72-21161
A temperature compensated light source using a light emitting diode
[NASA-CASE-ARC-10467-1] c09 N72-21249
Diode quad transducer and discriminator circuit
[NASA-CASE-ARC-10364-1] c10 N72-21276
Final environmental impact statement for Ames Research Center
[NASA-TM-X-67669] c11 N72-21286
Gas chromatograph injection system
[NASA-CASE-ARC-10344-1] c14 N72-21433
Interferometric rotation sensor
[NASA-CASE-ARC-10278-1] c14 N72-21434
Method and apparatus for swept-frequency impedance measurements of welds
[NASA-CASE-ARC-10176-1] c15 N72-21464
The kinetic and mechanical aspects of hydrogen-induced failure in metals
[NASA-TN-D-6691] c17 N72-21537
Some important considerations in the development of stress corrosion cracking test methods
[NASA-TM-X-68303] c14 N72-21905
**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. ELECTRONICS RESEARCH CENTER, CAMBRIDGE, MASS.**
An indicating system for aircraft
[NASA-CASE-ERC-10226-2] c02 N72-21008
Load insensitive electrical device
[NASA-CASE-XER-11046-2] c09 N72-21251
Lead attachment to high temperature devices
[NASA-CASE-ERC-10224-2] c09 N72-21253
Pressure sensitive transducer
[NASA-CASE-ERC-10087-2] c14 N72-21430
Improved satellite aided vehicle avoidance system
[NASA-CASE-ERC-10419] c21 N72-21631
Refractory dielectric semiconductors
[NASA-CASE-XER-08476-2] c26 N72-21800
**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. FLIGHT RESEARCH CENTER, EDWARDS, CALIF.**
Techniques for the evaluation of air-breathing propulsion systems in full-scale flight
[NASA-TM-X-68305] c28 N72-20983
Lifting body flight-test techniques
[NASA-TM-X-68306] c02 N72-20986
Terminal guidance system
[NASA-CASE-FRC-10049-1] c21 N72-21632
**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.**
Microstructure of radio aurora scattering regions
[NASA-TM-X-68302] c07 N72-21131
Device for determining relative angular position between a spacecraft and a radiation emitting celestial body
[NASA-CASE-GSC-11444-1] c14 N72-21418
Apparatus for vibrational testing of articles
[NASA-CASE-GSC-11302-1] c14 N72-21435
Azimuth bearing system and method
[NASA-CASE-GSC-11262-1] c16 N72-21503
Improved methods of performing coherent optical correlation
[NASA-TN-D-6581] c23 N72-21661
Dissociative excitation of vacuum ultraviolet emission features by electron impact on molecular gases. 3: CO2
[NASA-TM-X-65864] c24 N72-21676
Analysis of requirements for GEOS-C laser cube-corner reflector panels
[NASA-TM-X-65862] c31 N72-21890
**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. JOHN F. KENNEDY SPACE CENTER, COCOA BEACH, FLA.**
High speed direct binary-to-binary coded decimal converter
[NASA-CASE-KSC-10326] c08 N72-21197
Automatic frequency control loop including synchronous switching circuits
[NASA-CASE-KSC-10393] c09 N72-21247
Pressurized lighting system
[NASA-CASE-KSC-10644-1] c09 N72-21250
NASA, John F. Kennedy Space Center environmental impact statement
[NASA-TM-X-67740] c11 N72-21289
Evaluation of elastomers as gasket materials in pneumatic and hydraulic systems
[NASA-TN-D-6693] c18 N72-21556
Zero gravity shadow shield aligner
[NASA-CASE-KSC-10622-1] c31 N72-21893
**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LANGLEY RESEARCH CENTER, LANGLEY STATION, VA.**
Exploratory investigation of factors affecting the wing tip vortex
[NASA-TM-X-2516] c01 N72-20970
Supersonic aerodynamic characteristics of a low-aspect-ratio missile model with wing and tail controls and with tails in line and interdigitated
[NASA-TM-X-2531] c01 N72-20971
Lightweight, variable solidity knitted parachute fabric
[NASA-CASE-LAR-10776-1] c02 N72-21004
Results of intravehicular manned cargo-transfer studies in simulated weightlessness
[NASA-TN-D-6774] c05 N72-21075
Modification of one man life raft
[NASA-CASE-LAR-10241-1] c05 N72-21076

Method of detecting oxygen in a gas
[NASA-CASE-LAR-10668-1] c06 N72-21103
Radar calibration sphere
[NASA-CASE-XLA-11154] c07 N72-21117
Recorder using selective noise filter
[NASA-CASE-ERC-10112] c07 N72-21119
Stacked array of omnidirectional antennas
[NASA-CASE-LAR-10545-1] c09 N72-21244
Electro-mechanical sine/cosine generator
[NASA-CASE-LAR-10503-1] c09 N72-21248
Vibration mode synthesizer
[NASA-CASE-LAR-10310-1] c10 N72-21275
Final environmental impact statement for Langley
[NASA-TM-X-67680] c11 N72-21285
Computer program for solving compressible nonsimilar-boundary-layer equations for laminar, transitional, or turbulent flows of a perfect gas
[NASA-TM-X-2458] c12 N72-21312
Pitot-probe displacement in a supersonic turbulent boundary layer
[NASA-TN-D-6759] c12 N72-21313
Orbital and entry tracking accessory for globes
[NASA-CASE-LAR-10626-1] c14 N72-21416
A flow velocity and direction instrument
[NASA-CASE-LAR-10855-1] c14 N72-21417
Infrared horizon locator
[NASA-CASE-LAR-10726-1] c14 N72-21419
Infrared detectors
[NASA-CASE-LAR-10728-1] c14 N72-21422
Exposure interlock for oscilloscope cameras
[NASA-CASE-LAR-10319-1] c14 N72-21423
Combustion detector
[NASA-CASE-LAR-10739-1] c14 N72-21424
Fast scan control for deflection type mass spectrometers
[NASA-CASE-LAR-10766-1] c14 N72-21432
Pressure-tight seal for super alloy
[NASA-CASE-LAR-10170-1] c15 N72-21471
Deployable pressurized cell structure for a micrometeoroid detector
[NASA-CASE-LAR-10295-1] c15 N72-21472
Lyophilized spore dispenser
[NASA-CASE-LAR-10544-1] c15 N72-21477
Apparatus and method of molding
[NASA-CASE-LAR-10489-1] c15 N72-21484
Lamination method and apparatus
[NASA-CASE-XLA-11028] c15 N72-21486
Evacuated displacement compression molding
[NASA-CASE-LAR-10782-1] c15 N72-21487
Zero gravity liquid mixer
[NASA-CASE-LAR-10195-1] c15 N72-21488
Lathe tool bit and holder for machining fiberglass materials
[NASA-CASE-XLA-10470] c15 N72-21489
Nondestructive spot test method for magnesium and magnesium alloys
[NASA-CASE-LAR-10953-1] c17 N72-21528
Wind velocity profiles measured by the smoke-trail method at the Eastern Test Range, 1964
[NASA-TN-D-6746] c20 N72-21589
A computer program for Moessbauer data processing
[NASA-TM-X-2522] c24 N72-21677
Ring structure of a neutral gas cloud studied in a one-dimensional expansion into space
[NASA-TN-D-6760] c30 N72-21859
On the stability and pointing of an attached double-gimbal experiment package
[NASA-TN-D-6676] c30 N72-21863
Hot salt stress corrosion cracking of titanium alloys: Overview and impact on space shuttle application
[NASA-TM-X-68304] c17 N72-21926
Linear explosive comparison
[NASA-CASE-LAR-10800-1] c33 N72-21955
Ablation article and method
[NASA-CASE-LAR-10439-1] c33 N72-21956

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LEWIS RESEARCH CENTER, CLEVELAND, OHIO.**

FORTRAN program for generating a two-dimensional orthogonal mesh between two arbitrary boundaries
[NASA-TN-D-6766] c01 N72-20969
Peak axial-velocity decay with multi-element rectangular and triangular nozzles
[NASA-TM-X-68047] c02 N72-21001
Solar array cost reduction
[NASA-TM-X-68035] c03 N72-21033
A versatile silver oxide-zinc battery for synchronous orbit and planetary missions
[NASA-TM-X-68036] c03 N72-21034
Reactivity of simulated lunar material with fluorine
[NASA-TM-X-2533] c06 N72-21098
Switching regulator
[NASA-CASE-LEW-11005-1] c09 N72-21243
Development of a digital control system for a spacecraft propulsion test facility
[NASA-TM-X-68040] c11 N72-21287
Momentum flux in two phase two component low quality flow
[NASA-TM-X-68038] c12 N72-21311
Partial reflections of radio waves from the lower ionosphere
[NASA-TN-D-6742] c13 N72-21361
Comparison of conventional and microasperity elastohydrodynamic lubrication of a ballspinning in a nonconforming groove
[NASA-TN-D-6761] c15 N72-21469
Arched-outer-race ball-bearing analysis considering centrifugal forces
[NASA-TN-D-6765] c15 N72-21470
Journal bearings
[NASA-CASE-LEW-11076-1] c15 N72-21473
Method of forming superalloys
[NASA-CASE-LEW-10805-2] c15 N72-21485
Alloy softening in binary molybdenum alloys
[NASA-TM-X-68028] c17 N72-21525
Study of a columnar grain structure produced in a superalloy by gradient-annealing prealloyed powder extrusions
[NASA-TM-X-2545] c17 N72-21527
Thermal effects in equilibrium surface segregation in a copper/10-atomic-percent-aluminum alloy using Auger electron spectroscopy
[NASA-TM-X-2543] c17 N72-21532
Dispersion-strengthened nickel-alumina alloy produced from comminuted powders
[NASA-TM-X-2548] c17 N72-21533
Cobalt tungsten alloy
[NASA-CASE-LEW-10436-1] c17 N72-21538
Method and apparatus for controlling thermal nuclear reactors
[NASA-CASE-XLE-05799] c22 N72-21644
Neutronics analysis of an open-cycle high-impulse gas core reactor concept
[NASA-TM-X-2534] c22 N72-21646
Procedure for estimating effects of ion beam interaction with spacecraft
[NASA-TM-X-68043] c28 N72-21815
Optimization of engines for a commercial Mach 0.98 transport using advanced turbine cooling methods
[NASA-TM-X-68031] c28 N72-21816
Performance and control study of a low-pressure-ratio turbojet engine for a drone aircraft
[NASA-TM-X-2537] c28 N72-21817
Technical evaluation report on Propulsion and Energetics Panel 38th Meeting on Inlets and Nozzles for Aerospace Engines
[NASA-TM-X-67741] c28 N72-21819
Single grid accelerator system
[NASA-CASE-XLE-10453-2] c28 N72-21821
Optical properties of thermal control coating contaminated by MMH/N2O4 5-pound thruster in a vacuum environment with solar simulation
[NASA-TM-X-68044] c33 N72-21952
Diffusive and radiative effects on vaporization times of drops in film boiling
[NASA-TM-X-68037] c33 N72-21953

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. MANNED SPACECRAFT CENTER, HOUSTON, TEX.**

Optical range finder having nonoverlapping complete images
[NASA-CASE-MSC-12105-1] c14 N72-21409
An indirect optimization method with improved convergence characteristics
[NASA-TM-X-58088] c19 N72-21567
Apollo experience report: Lunar module reaction control system
[NASA-TN-D-6740] c31 N72-21887

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALA.**

Photoetching of metal-oxide layers
[NASA-CASE-ERC-10108] c06 N72-21094
Polymerizable disilanols having in-chain perfluoroalkyl groups
[NASA-CASE-MFS-20979-2] c06 N72-21101
Beam lead integrated circuit package, and method
[NASA-CASE-MFS-21374] c10 N72-21274
High Energy Astronomy Observatory, Mission C, Phase A. Volume 1: Executive summary
[NASA-TM-X-64652-VOL-1] c11 N72-21282
High Energy Astronomy Observatory, Mission C, Phase A. Volume 2: Preliminary analyses and conceptual design
[NASA-TM-X-64652-VOL-2] c11 N72-21283
High Energy Astronomy Observatory, Mission C, Phase A. Volume 3: Appendices
[NASA-TM-X-64652-VOL-3] c11 N72-21284
Liquid aerosol dispenser
[NASA-CASE-MFS-20829] c12 N72-21310
Optical probing of supersonic flows with statistical correlation
[NASA-CASE-MFS-20642] c14 N72-21407
Mechanically actuated triggered hand
[NASA-CASE-MFS-20413] c15 N72-21463
Process and apparatus for making diamonds
[NASA-CASE-MFS-20698-2] c15 N72-21481
Nonflammable coating compositions
[NASA-CASE-MFS-20486] c18 N72-21557
Analytical and experimental investigation of the coaxial plasma gun for use as a particle accelerator
[NASA-TN-D-6687] c25 N72-21691

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, WASHINGTON, D.C.**

Semiconductor-ferroelectric memory device
[NASA-CASE-ERC-10307] c08 N72-21198
Digital circuits for computer applications: A compilation
[NASA-SP-5949[01]] c08 N72-21209
Seals and sealing techniques
[NASA-SP-5905[03]] c15 N72-21480
Shielded cathode mode bulk effect devices
[NASA-CASE-ERC-10119] c26 N72-21701
Spacecraft platform cost estimating relationships
[NASA-TM-X-68851] c31 N72-21894

**NATIONAL AEROSPACE LAB., AMSTERDAM (NETHERLANDS).**

Lifting aerofoils with supercritical shock-free flow
[NLR-MP-70015-U] c01 N72-20972

**NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER, ATLANTIC CITY, N.J.**

The development of a motion picture measurement instrument for aptitude for air traffic control
[AD-735942] c05 N72-21085

**NATIONAL BUREAU OF STANDARDS, WASHINGTON, D.C.**

Search and rescue simulation model. Phase 3 report: Calibration/validation/investigation
[AD-735418] c11 N72-21305
The thermodynamics of chemical species important in aerospace technology
[AD-736039] c17 N72-21553
Electronic density of states
[NBS-SP-323] c26 N72-21702
Soft X-ray emission spectrum of Al in AuAl2 c26 N72-21739
Virtual impurity level density of states as investigated by resonance tunneling c26 N72-21749
What properties should the density of states have in order that the system undergoes a phase transition? c26 N72-21750
Relevance of Knight shift measurements to the electronic density of states c26 N72-21776
Correlation of changes in Knight shift and soft X-ray emission edge height upon alloying c26 N72-21780

**NATIONAL LENDING LIBRARY FOR SCIENCE AND TECHNOLOGY, BOSTON SPA [ENGLAND].**

The preferential position of tungsten carbide in the constitution of cemented carbides
[NLL-TRANS-746-1099-[9022.401]] c06 N72-21091
Preparation of nitrides by plasma jets
[NLL-RTS-6884] c06 N72-21092
The surface chemistry of adhesion
[NLL-RTS-6925] c06 N72-21093
Effect of mass transfer on the rheological behaviour of fluids
[NLL-RTS-6990] c12 N72-21308
A contribution to the geometrical theory of steady motion of a fluid
[NLL-M-22062-[5828.4F]] c12 N72-21309
Measurement of the absorption coefficient in the atmosphere at wavelength of lambda equals 5.28 - 20 cm
[NLL-M-22050-[5828.4F]] c13 N72-21349
Nature observation: A no. 1 problem
[NLL-M-22220-[5828.4F]] c13 N72-21350
The sun-atmosphere experiment
[NLL-M-22221-[5828.4F]] c13 N72-21351
Spectra of the absorption of atmospheric gases in vacuum ultraviolet regions
[NLL-M-22123-[5828.4F]] c13 N72-21352
Inertial gravity waves and meso-scale wind structure in jet streams
[NLL-M-22060-[5828.4F]] c13 N72-21353
Coulometric detector for gas chromatography communication 3: Determination of the micro-impurities of nitrogen oxides, sulphur dioxide and amonia in gases
[NLL-M-22138-[5828.4F]] c14 N72-21404
Research at works laboratories and institutes. of I. P. Bardin Central Research Institute for Ferrous Metallurgy.
[NLL-M-21286-[5828.4F]] c17 N72-21514
Superplasticity: Are we to expect a revolution in metallurgy?
[NLL-RTS-6944] c17 N72-21515
Determination of structural changes during annealing of strain hardened, [work hardened] metals
[NLL-RTS-6799] c17 N72-21516
Polynomials orthogonal to holomorphic functions of many complex variables and an analogue of the Riesz-Fischer theorem
[NLL-M-22038-[5828.4F]] c19 N72-21566
Features of the distribution of kinetic energy of atmospheric motions over the USSR
[NLL-M-22049-[5828.4F]] c20 N72-21581
Some aspects of the statistical analysis of the temperature regime
[NLL-M-22065-[5828.4F]] c20 N72-21582
Temperature distribution in the North Atlantic before the severe winter of 1969
[NLL-M-22215-[5828.4F]] c20 N72-21583
Some climatological parameters of the temperature field of the North Atlantic
[NLL-M-22214-[5828.4F]] c20 N72-21584

Aspects of machine classification of meteorological entities and types of temperature regime in Taskent in winter
[NLL-M-22039-[5828.4F]] c20 N72-21585
Calendar singularities of 24-hour amounts of rain of 30 mm or more
[NLL-M-22061-[5828.4F]] c20 N72-21586
Problems of the four-dimensional assimilation of meteorological observational data
[NLL-M-22063-[5828.4F]] c20 N72-21587
An investigation on the distribution of raindrops associated with the passage of cold front, especially of comparison beteen echo intensity measured by pulse integrator and rain intensity on the ground
[NLL-M-22067-[5828.4F]] c20 N72-21588
The theory of air restriction of noise within cylindrical shells
[NLL-M-22125-[5828.4F]] c23 N72-21660
A new method of infrared examination of adsorption on clean metal and semiconductor surfaces produced under high or ultrahigh vacuum
[NLL-RTS-6710] c26 N72-21699
Double injection and electroluminescence in doped anthracene crystals
[NLL-TRANS-2818-[9022.81]] c26 N72-21700
Meteors viewed through the telescopes
[NLL-M-22218-[5828.4F]] c30 N72-21856
Formation and evolution of nitrogen oxides in internal combustion engines
[NLL-M-22139-[5828.4F]] c33 N72-21948
Nucleate boiling heat transfer in binary liquid mixtures
[NLL-LB/G/3091-[9091.9F]] c33 N72-21949
Absolute analysis of the thermal conductivity of argon in the shock tube
[NLL-M-22129-[5828.4F]] c33 N72-21950
Heat exchangers of compact design
[NLL-M-22137-[5828.4F]] c33 N72-21951
The thesaurus in informatics and theoretical semantics
[NLL-RTS-6886] c34 N72-21965
Major discoveries by Soviet physicists
[NLL-M-22112-[5828.4F]] c34 N72-21966

**NATIONAL MATERIALS ADVISORY BOARD, WASHINGTON, D.C.**
Catalog of selected reports
[AD-735150] c17 N72-21551

**NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, BOULDER, COLO.**
Determining distance to lightning strokes from a single station
[NASA-CASE-KSC-10698-1] c07 N72-21159

**NATIONAL RESEARCH CORP., CAMBRIDGE, MASS.**
Static strength of film reinforced mechanical joints in fibrous composites
[AD-735953] c15 N72-21493

**NATIONAL RESEARCH COUNCIL OF CANADA, OTTAWA [ONTARIO].**
Observations of 48 MHz auroral radar propagation on a network in the auroral zone
c13 N72-21127
Electronic density of states in Eu-chalcogenides
c26 N72-21715

**NATIONAL SCIENCE FOUNDATION, WASHINGTON, D.C.**
Winter orographic cloud modification experiment in the Rocky Mountains of Colorado
[PB-205277-F] c20 N72-21599

**NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON, D.C.**
Aircraft accident report: Monmouth Airlines, Incorporated, scheduled air taxi, Beech 99, N986MA, Allentown-Bethlehem-Easton Airport, Allentown, Pennsylvania, 24 October 1971
[NTSB-AAR-72-3] c02 N72-21002
Aircraft accident report: Aloha Airlines, Incorporated, Vickers Viscount model 745D, N7415, Honolulu International Airport, Honolulu, Hawaii, 8 August 1971
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Aircraft accident report Delta Airlines, Incorporated Douglas DC-9-32, N3329L Louisville, Kentucky, 8 September 1970
[PB-205250] c02 N72-21020
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[PB-205097] c02 N72-21021
Briefs of aircraft accidents involving air taxi, US general aviation, 1969
[PB-205096] c02 N72-21022
Briefs of aircraft accidents involving alcoholic impairment of efficiency and judgement as a cause/factor, US general aviation, 1969
[PB-204991] c02 N72-21023
Briefs of accidents involving rotorcraft. US general aviation 1969
[PB-204812] c02 N72-21024
Briefs of accidents involving aerial application operations. US general aviation 1969
[PB-204811] c02 N72-21025
Briefs of aircraft accidents involving weather as a cause/related factor. US general aviation 1969
[PB-204926] c02 N72-21026

**NATIONAL WEATHER SERVICE, SILVER SPRING, MD.**
Developing techniques for automated forecasting of clear air turbulence
[AD-735941] c20 N72-21604

**NAVAL AEROSPACE MEDICAL INST., PENSACOLA, FLA.**
Orientation error accidents in regular Army UH-1 aircraft during fiscal year 1968: Relative incidence and cost
[AD-735457] c02 N72-21016
Selected anthropometric dimensions of naval aviation personnel
[AD-735101] c04 N72-21067

**NAVAL AIR DEVELOPMENT CENTER, JOHNSVILLE, PA.**
Statistical methods and their application to establishing flight maneuver loads design criteria for fighter aircraft
[AD-735472] c02 N72-21015
Assessment of temperature rise suppression by edge losses during irradiation
[AD-735881] c04 N72-21069
Portable detector of low amplitude electrocardiographic activity
[AD-735882] c05 N72-21084
Efficiency study of electrically short H-F antennas
[AD-735886] c07 N72-21176
Stress corrosion testing of titanium alloys
c32 N72-21912

**NAVAL AIR ENGINEERING CENTER, PHILADELPHIA, PA.**
Investigations in support of Mk 7 jet blast deflector cooling module design
[AD-735877] c33 N72-21963

**NAVAL AIR TEST CENTER, PATUXENT RIVER, MD.**
Carrier Suitability Tests
c02 N72-20988
US naval test pilot training
c11 N72-20996

**NAVAL CIVIL ENGINEERING LAB., PORT HUENEME, CALIF.**
Nuclear metering of soil density and moisture content at depth: Analysis of measurements, determination of errors, and evaluation of ability to detect temporal variations in soil properties
[AD-735448] c13 N72-21395

**NAVAL ELECTRONICS LAB. CENTER, SAN DIEGO, CALIF.**
HF propagation degradation during ionospheric storms
[AD-735868] c07 N72-21175
The band structure of tungsten as determined by ultraviolet photoelectric spectroscopy
c26 N72-21725

**NAVAL MEDICAL RESEARCH INST., BETHESDA, MD.**
Bibliography of reported biological phenomena [effects], and clinical manifestations attributed to microwave and radio frequency radiation
[AD-734391] c04 N72-21071

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[AD-735871] c13 N72-21389

**NAVAL ORDNANCE LAB., WHITE OAK, MD.**
Finite amplitude propagation of an underwater explosion shock wave along a strongly refracted ray tube
[AD-735875] c12 N72-21324
A computer program for CO2-N2-H2O gasdynamic laser gain and maximum available power
[AD-735878] c16 N72-21509
Fabrication and testing of carbon fiber/phenylated polyquinoxaline resin composites
[AD-735876] c18 N72-21563

**NAVAL POSTGRADUATE SCHOOL, MONTEREY, CALIF.**
Programmed pilotage as a means of improving rotorcraft performance in level flight
[AD-736537] c02 N72-21032
Models for message transmissions and interference-caused retransmission through a multi-channel satellite communications system
[AD-736115] c07 N72-21192
Inductorless bandpass filter realization using the Riordan gyrator
[AD-736533] c09 N72-21271
A matrix element of a solid state ultrasonic image converter using a light emitting diode in a nonscanning display
[AD-736535] c09 N72-21272
Properties of the discretely stratified microstructure in the Arctic Ocean
[AD-734973] c13 N72-21379
A bathymetric chart of Carmel Bay, California
[AD-734986] c13 N72-21380
An experimental method of determining ballistic winds making direct use of SIRS radiances
[AD-735898] c13 N72-21393

**NAVAL RESEARCH LAB., WASHINGTON, D.C.**
Biocidal properties of an anti-icing additive
[AD-735451] c04 N72-21068
Irradiation effects of reactor structural materials
[AD-735872] c22 N72-21659
On deriving density of states information from chemical bond considerations
c26 N72-21751

**NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS, MD.**
Influence of test method on stress corrosion behavior of aluminum alloys in sea water
c17 N72-21919

**NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, BETHESDA, MD.**
An evaluation of finite elemet methods for the computation of elastic stress intensity factors
[AD-735874] c32 N72-21943
Radiation from free-free beams under influences of light and heavy fluid loading
[AD-735873] c32 N72-21944

**NAVAL SUBMARINE MEDICAL CENTER, GROTON, CONN.**
Biochemistry of submarine and diving stress. 1: Lactate-pyruvate and redox chronic hypercapnia
[AD-734120] c04 N72-21057
Biochemistry of submarine and diving stress. 3: Plasma creatine, creatine phosphate and creatine phosphokinase responses to hypercapnia
[AD-734126] c04 N72-21058
Biochemistry of submarine and diving stress. 4: Responses of blood lactate-pyruvate and redox state to chronic exposure to 3 percent CO2
[AD-734122] c04 N72-21059

**NAVAL UNDERSEA RESEARCH AND DEVELOPMENT CENTER, SAN DIEGO, CALIF.**
Thermal structure dynamics in the upper 500 meters of the Indian Ocean
[AD-734668] c13 N72-21378
Vibrational analysis of the flexing head of the BQS-6 transducer
[AD-735459] c16 N72-21505

**NAVAL WEAPONS CENTER, CHINA LAKE, CALIF.**
Electroreflectance observation of band population effects in InSb
c26 N72-21752
Spin orbit effects in the electroreflectance spectra of semiconductors
c26 N72-21753

**NAVAL WEATHER SERVICE COMMAND, WASHINGTON, D.C.**
Summary of synoptic meteorologic observations: Southwest Asian coastal marine areas. Volume 3: Area 9, Cape Comorin; area 10, Mangalore; area 11, Panjim, area 12, Bombay
[AD-735441] c20 N72-21594

**NAVY CLOTHING AND TEXTILE RESEARCH UNIT, NATICK, MASS.**
Development and evaluation of an oxygen-sensing warning device
[AD-735377] c05 N72-21082

**NEW MEXICO STATE UNIV., UNIVERSITY PARK.**
An L-series X-ray spectroscopic study of the valence bands in iron, cobalt, nickel, copper, and zinc
[NASA-CR-126042] c26 N72-21742

**NEW MEXICO UNIV., ALBUQUERQUE.**
CAFA: A computer aided curve-fit and analysis program
[AD-735946] c08 N72-21230
Neutron irradiation effects on diffused GaAs laser diodes
[AD-735939] c16 N72-21507
The fabrication and experimental analysis of metal insulator semiconductor devices for radiation vulnerability studies
[AD-735947] c26 N72-21804

**NEW YORK UNIV., N.Y.**
Research studies in the theory of scattering of electromagnetic waves by metallic objects
[AD-735287] c07 N72-21170

**NEWCASTLE UNIV. [AUSTRALIA].**
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[NASA-CR-125935] c07 N72-21120

**NEWCASTLE-UPON-TYNE UNIV. [ENGLAND].**
Stress corrosion test methods: The European Federation of Corrosion contribution
c14 N72-21904

**NORTH AMERICAN ROCKWELL CORP., ANAHEIM, CALIF.**
Overview of aerospace vehicle computer applications
c08 N72-21212

**NORTH AMERICAN ROCKWELL CORP., DOWNEY, CALIF.**
Real time programs for aerospace vehicles
c08 N72-21215
Aircraft crash locator apparatus
[NASA-CASE-MFS-16609] c14 N72-21431
Apparatus for remote handling of materials
[NASA-CASE-LAR-10634-1] c15 N72-21476

**NORTH AMERICAN ROCKWELL CORP., SEAL BEACH, CALIF.**
Saturn S-2 quality assurance techniques, nondestructive testing processes. Volume 2: Radiographic references
[NASA-CR-123488] c15 N72-21467
Saturn S-2 quality assurance techniques, critical process control. Volume 7: Metallic materials
[NASA-CR-123487] c15 N72-21468

**NORTH AMERICAN ROCKWELL CORP., THOUSAND OAKS, CALIF.**
An ultra high vacuum system for determining the effects of gaseous environments on fatigue and fracture properties of metals
c14 N72-21916
**NORTH AMERICAN WEATHER CONSULTANTS, GOLETA, CALIF.**
A hydrometeorological data appraisal and design study in certain river basins in the western United States
[PB-204939] c20 N72-21609
**NORTHERN ILLINOIS UNIV., DEKALB.**
Knight shifts of the alkali metals
c26 N72-21778
**NORTHERN RESEARCH AND ENGINEERING CORP., CAMBRIDGE, MASS.**
Assessment of aircraft emission control technology
[PB-204878] c02 N72-21017
**NORTHROP SERVICES, INC., HUNTSVILLE, ALA.**
Planetary resonances, bi-stable oscillation modes, and solar activity cycles
[NASA-CR-2035] c30 N72-21870
**NORTHWESTERN UNIV., EVANSTON, ILL.**
Potential and charge density near the interface of a transition metal
[NASA-CR-126043] c26 N72-21748
Calculation of thermodynamic information based on the density of states curves of two allotropes of iron
c26 N72-21790
The reliability of estimating density of states curves from energy band calculations
c26 N72-21797
**NORWEGIAN DEFENCE RESEARCH ESTABLISHMENT, KJELLER.**
High latitude satellite scintillation
c07 N72-21140

## O

**OAK RIDGE NATIONAL LAB., TENN.**
Program for computing partial pressures from residual gas analyzer data
[NASA-CR-125938] c06 N72-21096
Effect of oxygen in static sodium on vanadium and vanadium alloys
[ORNL-4739] c06 N72-21108
Radiological instrument design investigation for OCD
[ORNL-TM-3370] c14 N72-21438
Compatibility of strontium compounds with superalloys at 900 C and 1100 C
[ORNL-4625] c17 N72-21541
Model for the economic analysis of high level radioactive waste management
[ORNL-4633] c22 N72-21648
Fast reactor shielding activity no. 40 01 61, 189A no. 10028
[ORNL-TM-3639] c22 N72-21654
Reference design of a 3 kW[e] steam Rankine cycle system for an isotope power plant
[ORNL-TM-2961] c22 N72-21655
Adjustment of calculated band structures for calcium by use of low temperature specific heat data
c26 N72-21710
Reference design for a thermoelectric isotope power unit employing heat pipe modules
[ORNL-TM-2959] c33 N72-21958
**OFFICE OF NAVAL RESEARCH, ARLINGTON, VA.**
Opportunities for Naval research
[AD-734183] c34 N72-21979
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[AD-735896] c20 N72-21605
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[AD-735897] c34 N72-21987
**OHIO STATE UNIV., COLUMBUS.**
TDMA space communications systems: Concepts and practical techniques
[AD-734255] c07 N72-21167
Laser absorption in the 5 micron band
[AD-736037] c16 N72-21512
Acoustic emissions and slow crack growth in high strength steel
c14 N72-21917
**OREGON UNIV., EUGENE.**
Excitonic effects in X-ray transitions in metals
c26 N72-21731
Alloy fermi surface topology information from superconductivity measurements
c26 N72-21788

## P

**PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION, BERKELEY, CALIF.**
The feasibility of using color aerial photography to detect and evaluate sulphur dioxide injury to timber stands
[PB-205279] c14 N72-21458
**PAN AMERICAN WORLD AIRWAYS, INC., PATRICK AFB, FLA.**
Omega short-term ranging precision
[AD-735372] c21 N72-21635
**PARIS UNIV. [FRANCE].**
High frequency backscatter observations at medium latitudes of high latitude field aligned irregularities
c07 N72-21149
**PARIS UNIV., ORSAY [FRANCE].**
Results of the Orsay storage ring ACO
[LAL-1256] c24 N72-21680
**PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.**
Modeling the D-region partial reflection experiment
[AD-735514] c13 N72-21386
Finite elements for shock analysis
[AD-735923] c32 N72-21946
**PENNSYLVANIA UNIV., PHILADELPHIA.**
Pennsylvania-Princeton army avionics research program: Antenna research task
[AD-735346] c07 N72-21171
What is a quasi-particle?
c26 N72-21729
Theory of fiber reinforced materials
[NASA-CR-1974] c32 N72-21932
**PHILIPS ZENTRALLABORATORIUM G.M.B.H., AACHEN [WEST GERMANY].**
Conductive coating for space vehicles
c18 N72-21558
**PICATINNY ARSENAL, DOVER, N.J.**
Application of superposition techniques to thermal degradation of epoxide resins
[AD-735687] c18 N72-21564
**PITTSBURGH UNIV., PA.**
Behavior of electron wave functions near the atomic nucleus and normalization screening theory in atomic photoeffect
[NYO-3829-75] c24 N72-21678
On the terms excluded in the multiple-scattering series
c26 N72-21766
**POLYTECHNIC INST. OF BROOKLYN, N.Y.**
Microwave transmission and instrument research
[AD-735366] c23 N72-21673
**PRATT AND WHITNEY AIRCRAFT, MIDDLETOWN, CONN.**
Electronic densities of states and optical properties of CsCl type intermetallic compounds
c26 N72-21704
The calculation of densities of states by LCAO interpolation of energy bands with application to iron and chromium
c26 N72-21705
**PRINCETON UNIV., N.J.**
A brief survey on metal fatigue
[AD-735700] c17 N72-21550
Micro-rocket impulsive thrusters
[AD-735381] c28 N72-21823
**PURDUE UNIV., LAFAYETTE, IND.**
Adaptive computer control of a glass coating process
[AD-735154] c15 N72-21500

## Q

**QUEENS UNIV., KINGSTON [ONTARIO].**
Density of states in alpha and beta brass by positron annihilation
c26 N72-21745

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**RADIO AND SPACE RESEARCH STATION, SLOUGH [ENGLAND].**
Polarization effects on sky-wave paths at high latitudes
c07 N72-21145
**RADIO CORP. OF AMERICA, LANCASTER, PA.**
Photomultiplier tube for efficient infrared detection
[AD-735323] c23 N72-21672
**RADIO CORP. OF AMERICA, PRINCETON, N.J.**
DC-electroluminescent flat panel display
[AD-735342] c09 N72-21267
Model density of states for high transition temperatures beta-tungsten superconductors
[NASA-CR-126047] c26 N72-21793
ITOS/space shuttle study
[NASA-CR-122398] c31 N72-21895
**RADIO CORP. OF AMERICA, SOMERVILLE, N.J.**
Common-base versus common-emitter performance and reliability for VHF stages
[AD-735755] c09 N72-21268
**RAND CORP., SANTA MONICA, CALIF.**
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[AD-735651] c10 N72-21278
A simple model to elucidate the utility of weather forecasting in military operations: Weather and warplanes 3
[AD-735261] c20 N72-21602
Uniformity theorems in missile duels
[AD-735260] c34 N72-21985
**RAYTHEON CO., SUDBURY, MASS.**
Phase coherent HF radar observations of barium releases in the Arctic ionosphere
c07 N72-21136
Ray tracing synthesis of HF radar signatures from Gaussian plasma clouds
[AD-736040] c12 N72-21328
**RCA INTERNATIONAL SERVICE CORP., PATRICK AFB, FLA.**
Omega short-term ranging precision
[AD-735372] c21 N72-21635
**RENSSELAER POLYTECHNIC INST., TROY, N.Y.**
Study of the effect of hydrostatic pressure on self diffusion rates in hexagonal metals
[RPI-3820-5] c17 N72-21545
**RESEARCH INST. OF GEODESY, PRAGUE [CZECHOSLOVAKIA].**
Satellite gravity studies
c13 N72-21333
Polygons for studying the secular variations of the acceleration of gravity on the territory of Czechoslavakia
c13 N72-21336
Recent crustal movements in Czechoslavakia
c13 N72-21343
Correlation between deflections of the vertical and the axes of zones of increased macroseismic mobility
c13 N72-21346
**RESEARCH INST. OF NATIONAL DEFENCE, STOCKHOLM [SWEDEN].**
Microwave radiometry and its potential application to earth resources surveys. Knowledge of material properties needed for analysis of microwave radiometric data
[RAC-0-3-R16] c07 N72-21163
**REYNOLDS METALS CO., RICHMOND, VA.**
Progress toward standarization of SCC test techniques by the American Society for Testing and Materials
c14 N72-21902
**RICE UNIV., HOUSTON, TEX.**
Numerical experiments on Hestenes' method of multipliers for mathematical programming problems
[PB-205311] c19 N72-21575
A modification of the method of multipliers for mathematical programming problems
[PB-205312] c19 N72-21576
**ROCKETDYNE, CANOGA PARK, CALIF.**
Phenomenology of synergistic catalyzed propellants
[AD-736222] c27 N72-21814
**ROME AIR DEVELOPMENT CENTER, GRIFFISS AFB, N.Y.**
High altitude hs signal tranmission characteristics
c07 N72-21144
Waveform Processing System [WPS]
[AD-735749] c08 N72-21241
Wavefront distortions caused by thermally induced mirror deformations
[AD-735282] c23 N72-21668
**ROME UNIV. [ITALY].**
Subprograms for the calculation of spin matrix elements using the Zemach method
[NOTA-INTERNA-328] c24 N72-21683
Exact statistical-mechanical treatment of a one-demensional quantal many-body system
[NOTA-INTERNA-332] c24 N72-21684
Nuclear core renormalization. Part 1: Coulomb energy differences
[NOTA-INTERNA-344-PT-1] c24 N72-21685
Experiments on electron-positron colliding beams
[NOTA-INTERNA-343] c24 N72-21686
Elementary pion with transverse momentum cut-off
[NOTA-INTERNA-342] c24 N72-21687
Angular behaviour of the K/pi ratio at high energy in the multi-Regge model
[NOTA-INTERNA-338] c24 N72-21688
Muon pair production by electron positron collisions in the geV region
[NOTA-INTERNA-336] c24 N72-21689
**ROORKEE UNIV. [INDIA].**
T matrix theory of density of states in disordered alloys: Application to beta brass
c26 N72-21765
**ROUEN UNIV. [FRANCE].**
Shock tube for optical studies on an argon plasma
[FRNC-TH-70] c11 N72-21302
Electric conductivity perpendicular to a magnetic field in air and nitrogen plasmas ionized by a shock wave
[FRNC-TH-75] c25 N72-21694
**ROYAL AIR FORCE, FARNBOROUGH [ENGLAND].**
Training pilots to assess flight systems at the Empire Test Pilots' School
c11 N72-20995
**ROYAL AIRCRAFT ESTABLISHMENT, BEDFORD [ENGLAND].**
Stability and control tests on a slender wing research aircraft
c02 N72-20990
**ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH [ENGLAND].**
The effect of vibration on the human body
[RAE-LIB-TRANS-1611] c04 N72-21051

An analytical method for investigating the transient processes in a single phase bridge rectifier circuit
[RAE-LIB-TRANS-1620] c10 N72-21273
On the spectra of wind driven waves at small fetches
[RAE-LIB-TRANS-1634] c13 N72-21363
The influence of grain size on the stress-strain relationship of tensile tested fcc metals
[RAE-LIB-TRANS-1585] c32 N72-21934
ROYAL INST. OF TECH., STOCKHOLM (SWEDEN).
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[TRITA-EPP-72-02] c29 N72-21851
ROYAL RADAR ESTABLISHMENT, MALVERN (ENGLAND).
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c07 N72-21134

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SACLANT ASW RESEARCH CENTER, LA SPEZIA (ITALY).
The calculation of the surface backscattering coefficient of underwater sound from measured data
[AD-735995] c13 N72-21390
SANDIA LABS., ALBUQUERQUE, N.MEX.
Dyamics of a gyroscope on an elastic suspension
[SC-T-713086] c14 N72-21437
Fermi surface properties of the noble metals at normal volume and as a function of pressure
c26 N72-21711
Orbital symmetry contributions to electronic density of states of AuAl
c26 N72-21738
SANDIA LABS., LIVERMORE, CALIF.
Method for designing feedback networks insensitive to variations in amplifier gains
[SCL-DR-710094] c10 N72-21277
SASKATCHEWAN UNIV., SASKATOON.
Polarization of waves scattered from aurora
c07 N72-21133
SCHOOL OF AEROSPACE MEDICINE, BROOKS AFB, TEX.
Body weight variation in primates exposed to 55 MeV protons
[AD-734779] c04 N72-21066
A portable, self-contained digital thermometer
[AD-735662] c05 N72-21087
SCIENTIFIC TRANSLATION SERVICE, ANN ARBOR, MICH.
Selective development of pits in a stainless steel in an oxidizing chloride medium
[AEC-TR-7289] c17 N72-21543
Corrosion of zirconium alloys in superheated steam results of long-term tests
[AEC-TR-7287] c17 N72-21544
SCIENTIFIC TRANSLATION SERVICE, SANTA BARBARA, CALIF.
Stability and control of hypersonic aircraft
[NASA-TT-F-14235] c02 N72-21006
Studies on solid electrolyte cell. Part 3: The solid electrolyte cell with Ag3SI thin film
[NASA-TT-F-14196] c03 N72-21035
Study on sand movement by wind
[NASA-TT-F-14215] c13 N72-21359
Utilization of atomic absorption spectrophotometry for the study of adsorption kinetics in the liquid phase
[NASA-TT-F-14263] c14 N72-21425
Influence of certain physico-chemical factors on the adsorption capacity of active carbons with respect to rhenium
[NASA-TT-F-14250] c17 N72-21535
Metallic dispersonic as solid samples in atomic absorption
[NASA-TT-F-14232] c17 N72-21536
SCRIPPS INSTITUTION OF OCEANOGRAPHY, SAN DIEGO, CALIF.
Survey of hydrophone acceleration responses
[AD-735931] c13 N72-21391
SIERRA RESEARCH CORP., BUFFALO, N.Y.
Design study of general aviation collision avoidance system
[NASA-CR-112023] c21 N72-21625
SIGNATRON, INC., LEXINGTON, MASS.
Problems and solutions in statistical detection and estimation
[AD-735760] c07 N72-21181
SINGER-LIBRASCOPE, GLENDALE, CALIF.
Programming characteristics of future G and C computers
c08 N72-21216
Environmental test program for the high contrast photochromic projection device
[AD-735281] c09 N72-21263
SKODA WORKS, PILSEN (CZECHOSLOVAKIA).
Experimental investigation of momentum and heat transfer in turbulent flow of air in a fuel assembly model
[ZJE-111] c22 N72-21651
SMALL BUSINESS ADMINISTRATION, WASHINGTON, D.C.
Seals and sealing techniques
[NASA-SP-5905(03)] c15 N72-21480
SMITHSONIAN ASTROPHYSICAL OBSERVATORY, CAMBRIDGE, MASS.
Atomic hydrogen maser with bulb temperature control to remove wall shift in maser output frequency
[NASA-CASE-HQN-10654-1] c16 N72-21502
Analysis of solar ultraviolet lines
[NASA-CR-125981] c29 N72-21829
Apollo contamination analysis
[NASA-CR-125934] c31 N72-21885
SOCIETE NATIONALE INDUSTRIELLE AEROSPATIALE, PARIS (FRANCE).
Participation of the study of corrosion under tension of certain high resistance aluminum alloys
c14 N72-21921
SOCIETE NOUVELLE DES ACIERIES DE POMPEY (FRANCE).
Investigation of an accelerated stress corrosion cracking method
c32 N72-21924
SOUTHEASTERN MASSACHUSETTS UNIV., NORTH DARTMOUTH.
Torpedo drag reduction using magnetohydrodynamic boundary layer control
[AD-735471] c12 N72-21320
SOUTHERN METHODIST UNIV., DALLAS, TEX.
Scattering of sound from layered hollow elastic cylinders
[AD-735859] c23 N72-21670
SOUTHWEST RESEARCH INST., SAN ANTONIO, TEX.
Investigation of the effects of trace metals on the thermal stability of JP-7 fuels
[AD-736475] c27 N72-21813
SPACO, INC., HUNTSVILLE, ALA.
Ultrasonic scanning system for in place inspection of brazed tube joints
[NASA-CASE-MFS-20767] c15 N72-21482
SPERRY RAND CORP., HUNTSVILLE, ALA.
Frequency division multiplex technique
[NASA-CASE-KSC-10521-1] c07 N72-21160
SPERRY RAND CORP., ST. PAUL, MINN.
Aerospace computer memory techniques
c08 N72-21218
SPERRY RAND CORP., TROY, MICH.
Development of a variable delivery positive displacement fuel pump
[AD-735259] c15 N72-21496
STANFORD RESEARCH INST., MENLO PARK, CALIF.
Mathematical analysis and description of continuous human behavior
[AD-734681] c04 N72-21060
Polar propagation effects on VHF-UHF radars
c07 N72-21126
Auroral radar backscatter studies from Homer, Alaska
c07 N72-21129
Frequency distortion in auroral HF propagation
c07 N72-21143
Triggered lightning and some unsuspected lightning hazards
[AD-735917] c13 N72-21392
Analysis of techniques for describing the state of the sky through automation
[AD-735213] c20 N72-21601
STANFORD UNIV., CALIF.
Optimal regulation of physiological systems via real-time adaptive model synthesis
[AD-735900] c05 N72-21088
Multiloop RC active filter apparatus having low parameter sensitivity with low amplifier gain
[NASA-CASE-ARC-10192] c09 N72-21245
A lower bound for sorting networks that use the divide-sort-merge strategy
[AD-735901] c10 N72-21280
Acoustical diffraction radiation
[AD-735922] c12 N72-21327
Infrared spectrometry studies. Phase 4: Emittance spectra of selected targets from mission 108 airborne data
[NASA-CR-115524] c13 N72-21356
Spacecraft attitude control method and apparatus
[NASA-CASE-HQN-10439] c21 N72-21624
Optical density of states ultraviolet photoelectric spectroscopy
[NASA-CR-126040] c26 N72-21720
The density of states and photoemission from indium and aluminum
c26 N72-21721
A guide to the literature on application of communications satellites to educational development
[NASA-CR-125933] c34 N72-21968
STEVENS INST. OF TECH., HOBOKEN, N.J.
Twenty-ton wheeled air cushion lighter conceptual design
[AD-735667] c02 N72-21012
Twenty-ton wheeled air cushion lighter conceptual design
[AD-735667] c02 N72-21012
STRATHCLYDE UNIV., GLASGOW (SCOTLAND).
Soft X-ray band spectra and their relationships to the density of states
c26 N72-21737
Soft X-ray emission from alloys of aluminum with silver, copper, and zinc
c26 N72-21740
SYRACUSE UNIV., N.Y.
Optic and auditory nerve and perception studies
[AD-734017] c04 N72-21073
SYSTEM DEVELOPMENT CORP., SANTA MONICA, CALIF.
A survey of digital signal processing techniques for speech analysis
[AD-735919] c07 N72-21184
The cepstrum, the cepstrally smoothed log spectrum and the Chirp Z-transform
[AD-735921] c07 N72-21185
An on-line system for hand-printed input
[NASA-CR-126036] c08 N72-21208

## T

TECHNICAL UNIV. OF DENMARK, LYNGBY.
On the polar slant E Condition, its identification, morphology and relationship to other electrojet phenomena
c07 N72-21148
TECHNION - ISRAEL INST. OF TECH., HAIFA.
The buckling of stiffened and unstiffened shell structures
[AD-736044] c32 N72-21947
TECHNISCHE HOCHSCHULE IN GRAZ (AUSTRIA).
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[AD-734599] c07 N72-21166
TECHNISCHE HOCHSCHULE, DARMSTADT (WEST GERMANY).
Stability investigations of plates using finite element method based on an expanded variation principle
c32 N72-21935
TECHNISCHE HOGESCHOOL, DELFT (NETHERLANDS).
The determination of stability derivatives and performance characteristics from dynamic manoeuvres
c02 N72-20992
TECHTRAN CORP., GLEN BURNIE, MD.
A micromethod for rapid and specific series determination of the protein content of intact microorganisms
[NASA-TT-F-14253] c04 N72-21042
Changes in the nervous system during a 120 day clinostatic hypokinesia and the prophylaxis of hypokinesic disorders
[NASA-TT-F-14225] c04 N72-21046
Movement of water through the surface layers of the soil
[NASA-TT-F-14247] c13 N72-21360
Results of the development and testing of the AM-15 bimetallic thermometer probe
[NASA-TT-F-14226] c14 N72-21413
Dynamic thermocapacitive soil-moisture sensor
[NASA-TT-F-14265] c14 N72-21414
TELDIX LUFTFAHRT-AUSRUESTUNGS G.M.B.H., HEIDELBERG (WEST GERMANY).
Systems tasks for advanced aircraft navigation systems
c21 N72-21222
TELEDYNE SYSTEMS CO., NORTHRIDGE, CALIF.
Guidance and control computer system design
c08 N72-21214
Aerospace computer input-output techniques
c08 N72-21219
Helicopter guidance and control computer systems
c08 N72-21223
TEXAS A&M UNIV., COLLEGE STATION.
Remote sensing in hydrology: A survey of applications with selected bibliography and abstracts
[NASA-CR-126025] c13 N72-21357
A comparison of two approaches for category identification and classification analysis from an agricultural scene
[NASA-CR-126024] c13 N72-21358
TEXAS UNIV., AUSTIN.
The extraction of sleep information from heart rate data: Analysis of the sleep cycle
[AD-734283] c04 N72-21061
THERMO ELECTRON ENGINEERING CORP., WALTHAM, MASS.
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[PB-205474] c05 N72-21086
TRANSLATION CONSULTANTS, LTD., ARLINGTON, VA.
Experimental and clinical studies in the treatment of arrhythmias due to digitalis by sodium citrate
[NASA-TT-F-14194] c04 N72-21045
Interpretation of aerial photographs for geomorphological research
[NASA-TT-F-624] c13 N72-21364
Use of a laser for spectral-isotopic determination of volumetric and surface content of oxygen in metals
[NASA-TT-F-14148] c16 N72-21501

Preparation and crystal structure of KAgO and CsAgO
[NASA-TT-F-14192] c26 N72-21799
Preliminary results of lunar soil study
[NASA-TT-F-13961] c30 N72-21861
Meteorites are interplanetary space probes
[NASA-TT-F-13962] c30 N72-21862
Measurement of the concentration of solid component of substances in outer space, performed aboard spacecraft
[NASA-TT-F-14188] c30 N72-21864
Lunar soil in Mare Imbrium
[NASA-TT-F-14181] c30 N72-21865
The Luna 17 automatic station on Mare Imbrium
[NASA-TT-F-14176] c30 N72-21866
Morphology of small craters in the lunar maria
[NASA-TT-F-14177] c30 N72-21867
Statistics on small craters from Lunokhod 1 data
[NASA-TT-F-14178] c30 N72-21868
Statistical analysis of rock distribution from Lunokhod 1 data
[NASA-TT-F-14180] c30 N72-21869

**TRANSPORTATION SYSTEMS CENTER, CAMBRIDGE, MASS.**
The calculation of aircraft collision probabilities
[DOT-TSC-FAA-71-27] c02 N72-20997
Visibility concepts and measurement techniques for aviation purposes
[DOT-TSC-FAA-71-25] c02 N72-20998
Aircraft wake vortex sensing systems
[DOT-TSC-FAA-72-13] c02 N72-20999
Proposed control tower and cockpit visibility readouts based on an airport-aircraft information flow system
[DOT-TSC-FAA-71-18] c02 N72-21000
A review of available L-band and VHF aircraft antennas for an aircraft satellite communications link
[PB-204799] c07 N72-21165
Occupant motion sensors: Methods of detection and analysis
[PB-204809] c14 N72-21447
Occupant motion sensors
[PB-204808] c14 N72-21448
Development of anticipatory automobile crash sensors
[PB-204806] c14 N72-21449
Automatic data reduction from aerial photographs
[PB-204810] c14 N72-21450
Two candidate systems for unmanned fog bank detection
[PB-204805] c14 N72-21451
Survey of meteorological remote sensors
[PB-204793] c14 N72-21452
Survey of aircraft emissions and related instrumentation
[PB-204794] c20 N72-21592
Evaluation of air traffic control models and simulations
[DOT-TSC-FAA-71-7] c21 N72-21626
Microwave scanning beam approach and landing system phased array antenna
[DOT-TSC-FAA-71-29] c21 N72-21627
Accurate surveillance in the terminal area
[DOT-TSC-FAA-71-26] c21 N72-21628
Oceanic surveillance and navigation analysis, Fy 71
[DOT-TSC-FAA-71-13] c21 N72-21629
Evaluation of the FAA advanced flow control procedures
[DOT-TSC-FAA-72-8] c21 N72-21630
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[PB-205029] c09 N72-21265

**TRW SYSTEMS GROUP, REDONDO BEACH, CALIF.**
Studies of the formation and decay of triplet states of aromatic molecules
[AD-735483] c06 N72-21113
Wide range analog-to-digital converter with a variable gain amplifier
[NASA-CASE-NPO-11018] c08 N72-21200
Computers for satellite based navigation and guidance systems
c08 N72-21226
Development of laser instrumentation for particle measurement
[PB-205189] c14 N72-21457
Monopropellant hydrazine resistojet model specification
[NASA-CR-122377] c28 N72-21820
Pulsed electromagnetic thruster
[AD-735721] c28 N72-21824
Analysis of solar X-ray data from the OV5-1 [1967-40E]
[AD-735277] c29 N72-21852

**TRW, INC., CLEVELAND, OHIO.**
Interactions between creep, fatigue and strain aging in two refractory alloys
[NASA-CR-120891] c17 N72-21529

**TYCO LABS., INC., WALTHAM, MASS.**
Measuring the degree of conjoint action between stress and corrosion in stress corrosion
c32 N72-21908

## U

**UNIDEV, INC., HUNTSVILLE, ALA.**
Evaluation of Skylab IB sensitivity to on-pad winds with turbulence
[NASA-CR-123564] c31 N72-21878

**UNIFIED SCIENCE ASSOCIATES, INC., PASADENA, CALIF.**
Method of producing crystalline materials
[NASA-CASE-NPO-10440] c15 N72-21466

**UNITED KINGDOM ATOMIC ENERGY AUTHORITY, HARWELL [ENGLAND].**
Use of non destructive gamma activation for the analysis of rock and biological materials
[AERE-R-6910] c13 N72-21368
The electronic structure of disordered alloys
c26 N72-21758

**UNITED STATES STEEL CORP., MONROEVILLE, PA.**
The electronic properties of titanium interstitial and intermetallic compounds from soft X-ray spectroscopy
c26 N72-21743
Microscopic identification of stress corrosion cracking in steels with high yield strength
c32 N72-21925

**UTAH UNIV., SALT LAKE CITY.**
Role of exchange effects on the relationship between spin susceptibility and density of states of divalent metals
c26 N72-21779

**UTRECHT STATE UNIV. [NETHERLANDS].**
Determination of mercury in samples from the Dutch environment
[IRI-133-71-17] c06 N72-21111

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**VARIAN ASSOCIATES, PALO ALTO, CALIF.**
Megavolt-megampere electron gun study
[AD-735498] c09 N72-21262

**VIRGINIA POLYTECHNIC INST., BLACKSBURG.**
Nonequilibrium boundary layer flow on highly-swept hypersonic wings
[PB-204710] c01 N72-20975
Relationship of nitrogen content to the susceptibility of austenitic stainless steels to stress corrosion
[TID-25783] c17 N72-21539

## W

**WASHINGTON UNIV., SEATTLE.**
Multiple scattering effects on wave propagation in isotropic scattering media
[AD-735284] c07 N72-21169
Arctic technology development at the University of Washington
[AD-735957] c13 N72-21383

**WASHINGTON UNIV., ST. LOUIS, MO.**
A guide to the literature on application of communications satellites to educational development
[NASA-CR-125933] c34 N72-21968

**WATERLOO UNIV. [ONTARIO].**
One-dimensional relativistic theory of impurity states
c26 N72-21761
A domestic multi-modal goods distribution model with emphasis on air cargo
c34 N72-21969
Simulating the turnaround operation of passenger aircraft using the critical path method
c34 N72-21970
Notes for a short course on practical applications of regional development models
c34 N72-21971
A design method for the preparation of a preliminary urban land use/transport plan
c34 N72-21972

**WATERVLIET ARSENAL, N.Y.**
Interfacial energy and the high temperature strength of dispersion-strengthened gold-Al2O3 alloys
[AD-735710] c17 N72-21549
Nonclassical forced motion of stationary and rotating beams with tip masses
[AD-735683] c32 N72-21939

**WEATHER SQUADRON [24TH], LAREDO AFB, TEX. DETACHMENT 18.**
Terminal forecast reference file
[AD-735791] c20 N72-21615

**WEATHER WING [3RD], OFFUTT AFB, NEBR.**
Thermal parameters as a predictor of precipitation type for Loring AFB, Maine
[AD-735724] c20 N72-21616

**WEATHER WING [5TH], LANGLEY AFB, VA.**
The use of diurnal temperature and dew point curves
[AD-735276] c20 N72-21614

**WELDING INST., CAMBRIDGE [ENGLAND].**
Stress corrosion testing of welded joints
c14 N72-21910

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Ion-acoustic waves in aurora
c13 N72-21132
Angular deviation of radio waves
c07 N72-21139

**WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA.**
Demodulator for carrier transducers
[NASA-CASE-NUC-10107-1] c09 N72-21254
After heat distribution of a mobile nuclear power plant
[NASA-CR-120825] c22 N72-21647
FPMS life test
[WANL-4219-1] c22 N72-21656

**WESTINGHOUSE RESEARCH LABS., PITTSBURGH, PA.**
An apparatus for stress corrosion testing with large precracked WOL specimens
c32 N72-21914

**WHITE SANDS MISSILE RANGE, N.MEX.**
Secure communications at millimeter wavelengths
[AD-735686] c07 N72-21168

**WHITTAKER CORP., SAN DIEGO, CALIF.**
Viscoelastic wave propagation in unidirectional composites, part 4
[AD-734658] c18 N72-21559

**WILLIAMS COLL., WILLIAMSTOWN, MASS.**
Computer simulation model of coastal processes in eastern Lake Michigan
[AD-736224] c13 N72-21401

**WISCONSIN UNIV., MADISON.**
Evaluation of Jacobian determinants by Monte Carlo methods: Application to the quasiclassical approximation in molecular scattering
[NASA-CR-125978] c06 N72-21095
Statistical models
[AD-735197] c19 N72-21578

**WOODS HOLE OCEANOGRAPHIC INSTITUTION, MASS.**
Transport float measurements and hydrographic station data from three sections across the Gulf Stream near 67 degrees west: R. V. Crawford cruise 168, June - July 1968
[AD-734419] c13 N72-21374
Hudson '70 gravity observations 62.9 degrees - 57.5 degrees N along 150 degrees W
[AD-735114] c13 N72-21375
Deep towed hydrophone array
[AD-735885] c23 N72-21671

**WORCESTER POLYTECHNIC INST., MASS.**
Electrical resistivity as a function of hydrogen concentration in a series of palladium-gold alloy
c26 N72-21786

**WORLD METEOROLOGICAL ORGANIZATION, GENEVA [SWITZERLAND].**
Report of the second session of the Tropical Experiment Board
[GARP-SPEC-5] c20 N72-21591

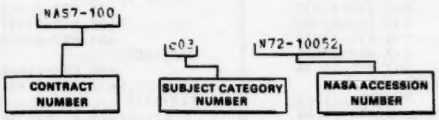
## Y

**YALE UNIV., NEW HAVEN, CONN.**
Lyapunov functions for quadratic differential equations with applications to adaptive control
[AD-735482] c19 N72-21573
Adaptive control using Lyapunov's direct method
[AD-735481] c19 N72-21574
Hydrogenation effects on palladium tunnel junctions
c26 N72-21789

# CONTRACT NUMBER INDEX



## Typical Contract Number Index Listing




Listings in this index are arranged alphanumerically by contract number. Under each contract number, the NASA accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order. The subject category number identifies the *STAR* category section in which the document is announced. The NASA accession number denotes the number by which the citation is identified in that section.

AF PROJ. A01774
c13 N72-21399
AF PROJ. 627 A00-AHT
c28 N72-21826
AF PROJ. 649L
c07 N72-21186
AF PROJ. 681D
c16 N72-21510
AF PROJ. 1431
c08 N72-21229
c08 N72-21239
AF PROJ. 1467
c32 N72-21941
AF PROJ. 2567
c01 N72-20974
AF PROJ. 3048
c15 N72-21499
c27 N72-21813
AF PROJ. 3058
c15 N72-21494
c27 N72-21812
AF PROJ. 3066
c15 N72-21496
AF PROJ. 3145
c03 N72-21036
c03 N72-21037
c03 N72-21040
c15 N72-21497
AF PROJ. 4362
c33 N72-21961
AF PROJ. 4600
c07 N72-21179
AF PROJ. 4610
c07 N72-21189
AF PROJ. 4751
c04 N72-21061
c23 N72-21673
AF PROJ. 5170
c21 N72-21636
AF PROJ. 5597
c09 N72-21263
AF PROJ. 5635
c07 N72-21170
AF PROJ. 6698
c20 N72-21600
AF PROJ. 7073
c25 N72-21696
AF PROJ. 7164
c04 N72-21055
AF PROJ. 7184
c05 N72-21089
AF PROJ. 7222
c04 N72-21065
AF PROJ. 7340
c18 N72-21561
AF PROJ. 7342
c18 N72-21559
AF PROJ. 7343
c21 N72-21643
AF PROJ. 7351
c17 N72-21554
AF PROJ. 7360
c30 N72-21875
AF PROJ. 7381
c18 N72-21565
AF PROJ. 7600
c13 N72-21394
AF PROJ. 7635
c07 N72-21177
AF PROJ. 7757
c04 N72-21066
AF PROJ. 7784
c05 N72-21083
AF PROJ. 7996
c05 N72-21087
AF PROJ. 8219
c02 N72-21030
c14 N72-21461
AF PROJ. 8666
c29 N72-21852
AF PROJ. 8682
c07 N72-21169
AF PROJ. 9749
c07 N72-21181
c19 N72-21578
c34 N72-21984
AF PROJ. 9750-01
c17 N72-21553
AF PROJ. 9767
c26 N72-21806
AF PROJ. 9781
c12 N72-21321
AF PROJ. 9782
c32 N72-21947
AF PROJ. 30580
c27 N72-21811
AF-AFOSR-ISSA-70-0002
c17 N72-21553
AF-AFOSR-0693-67
c19 N72-21568
AF-AFOSR-0699-67
c34 N72-21984
AF-AFOSR-0838-65
c26 N72-21727
AF-AFOSR-1450-68
c26 N72-21727
AF-AFOSR-1485-68
c12 N72-21321
AF-AFOSR-1488-68
c26 N72-21757
AF-AFOSR-1678-69
c26 N72-21766
AF-AFOSR-1803-69
c19 N72-21578
AF-AFOSR-2054-71
c26 N72-21806
ARPA ORDER 306
c23 N72-21666
ARPA ORDER 1057
c12 N72-21328
ARPA ORDER 1279
c16 N72-21512
ARPA ORDER 1320
c13 N72-21381
ARPA ORDER 1327
c07 N72-21184
c07 N72-21185
ARPA ORDER 1587
c16 N72-21513
ARPA ORDER 1645
c11 N72-21306
ARPA ORDER 1668
c13 N72-21383
ARPA ORDER 1783
c07 N72-21195
ARPA PROJ. 1F10-02
c13 N72-21381
ARPA SD-86
c26 N72-21792
ARPA SD-90
c18 N72-21707
ARPA SD-131
c26 N72-21754
c26 N72-21782
AT(04-3)-34
c13 N72-21354
AT(07-2)-1
c14 N72-21443
AT(29-1)-613
c09 N72-21256
AT(29-1)-789
c10 N72-21277
AT(29-2)-1163
c13 N72-21369
c13 N72-21371
AT(30-1)-3246
c14 N72-21440
AT(30-1)-3820
c17 N72-21545
AT(30-1)-3829
c24 N72-21678
AT(30-1)-4219
c22 N72-21656
AT(33-1)-GEN-5
c06 N72-21110
AT(33-1)-GEN-53
c06 N72-21109
AT(40-1)-3622
c13 N72-21366
AT(40-1)-3651
c24 N72-21679
AT(40-1)-3783
c14 N72-21442
AT(40-1)-4052
c17 N72-21539
AT(45-1)-1830
c14 N72-21441
AT(45-1)-2170
c15 N72-21490
AT(45-1)-2229
c13 N72-21367
AT(49-5)-2110
c22 N72-21659
CPA-70-4
c14 N72-21457
CPA-70-67
c20 N72-21598
CPA-70-72
c09 N72-21259
DA PROJ. 1F1-62202-AA-91
c21 N72-21640
DA PROJ. 1H1-62202-A-219
c07 N72-21171
DA PROJ. 1H6-62701-A-448
c07 N72-21178
c07 N72-21180
DA PROJ. 1H6-62705-A-055
c09 N72-21267
DA PROJ. 1H6-62705-A-056
c09 N72-21268
DA PROJ. 1H6-62705-A-058
c26 N72-21803
DA PROJ. 1H6-63703-D-654
c08 N72-21242
DA PROJ. 1N1-21401-D-195
c02 N72-21013
DA PROJ. 1OS-634701-D-257
c07 N72-21168
DA PROJ. 1S6-62705-A-055
c16 N72-21511
DA PROJ. 1S6-62705-A-058
c26 N72-21808
DA PROJ. 1T0-61101-A-91-A
c17 N72-21552
DA PROJ. 1T0-61102-B-31-A
c07 N72-21172
c07 N72-21173
c21 N72-21638
DA PROJ. 1T0-62105-A-329
c18 N72-21564
DA PROJ. 1T6-65702-D-127
c20 N72-21595
c20 N72-21596
c20 N72-21597
c20 N72-21607
c20 N72-21608
DA PROJ. 2H0-61102-B-71-D
c04 N72-21064
DA PROJ. 200-61102-B-11-B
c07 N72-21166
DA PROJ. 200-61102-B-32-D
c17 N72-21550
DA PROJ. 2T0-14501-B-81-B
c15 N72-21498
DA PROJ. 3A0-61102-B-71-B
c04 N72-21072
DA PROJ. 4A6-62707-A-852
c15 N72-21491
DA PROJ. 7X2-63304-D-215
c07 N72-21193
c09 N72-21264
c13 N72-21387
DA-PROJ. 1F1-62202-AA-91
c08 N72-21231
DA-28-043-AMC-02411(E)
c07 N72-21171
DA-31-124-ARO/D-440
c24 N72-21676
DA-44-009-AMC-1474(7)
c26 N72-21721
DA-49-083-OSA-3131
c17 N72-21551
DAABC7-67-C-0199
c08 N72-21232
DAABC7-69-C-0290
c09 N72-21267
DAABC7-70-C-0145
c09 N72-21268
DAABC7-70-C-0273
c23 N72-21672
DAABC7-72-Q-0166
c26 N72-21803
DAADC7-71-C-0136
c23 N72-21669
DAAG17-68-C-0036
c02 N72-21013
DAAK02-68-C-0089
c07 N72-21188
DAAK02-71-C-0027
c15 N72-21491
DAAK02-71-C-0114
c02 N72-21012
DAHC04-67-C-0025
c26 N72-21754
DAHC04-67-C-0027
c20 N72-21603
DAHC04-68-C-0002
c10 N72-21279
c15 N72-21498
DAHC04-69-C-0031
c12 N72-21323
DAHC04-69-C-0062
c17 N72-21550
DAHC15-67-C-0149
c07 N72-21184
c07 N72-21185
c08 N72-21208
DAHC19-70-C-0020
c04 N72-21064
DAHC60-71-C-0034
c28 N72-21823
DAJA37-70-C-0118
c07 N72-21166
DASA01-69-C-0092
c09 N72-21262
DASA01-70-C-0035
c06 N72-21115
DASA01-70-C-0075
c04 N72-21054
DASA01-70-C-0121
c25 N72-21697
DCA100-70-C-0078
c34 N72-21982

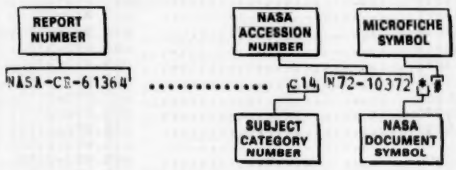
DGRST-69-02-039-00-212-75-01
c23 N72-21664
DI-14-01-001-2144
c33 N72-21960
DI-14-06-D-7053
c20 N72-21609
DOT-C-353-66
c09 N72-21265
DOT-CG-2310-A
c05 N72-21080
DOT-FA65WAI-96
c20 N72-21601
DOT-FA69WA-155
c20 N72-21604
DOT-TSC-50
c21 N72-21642
DOT-TSC-77
c21 N72-21626
DOT-TSC-98
c07 N72-21191
DOT-UT-109
c34 N72-21983
DR PROJ. 70-8
c32 N72-21940
DRME-68-34-481
c26 N72-21801
DRME-68-34-778
c26 N72-21802
EOOAR-0068-69
c04 N72-21055
EPA-68-04-0011
c02 N72-21017
ESSA-E-203-69N
c20 N72-21601
ESTEC-1218/70
c07 N72-21164
ESTEC-1471/71-EL
c07 N72-21163
FAA PROJ. AM-A-71-PRS-37
c05 N72-21078
FCC-RC-10134-70
c07 N72-21190
FSTC PROJ. T7023012301
c01 N72-20973
FSTC PROJ. 6040102
c28 N72-21825
FTD PROJ. 3066
c28 N72-21827
FTD PROJ. 60103
c20 N72-21593
FTD PROJ. 60107
c17 N72-21548
FTD PROJ. 20906391
c02 N72-21019
F04611-70-C-0052
c15 N72-21494
F04611-70-C-0076
c33 N72-21962
F04611-70-C-0087
c27 N72-21812
F04701-69-C-0066
c29 N72-21837
F04701-71-C-0172
c07 N72-21194
c13 N72-21397
c13 N72-21400
c13 N72-21403
c16 N72-21508
c16 N72-21510
c29 N72-21855
c30 N72-21876
F08606-68-C-0040
c21 N72-21635
F19628-68-C-0253
c29 N72-21852
F19628-69-C-0117
c07 N72-21170
F19628-69-C-0123
c07 N72-21169
F19628-70-C-0022
c07 N72-21189
F19628-70-C-0185
c08 N72-21234
c08 N72-21235
c08 N72-21236
c08 N72-21237
c08 N72-21238
F19628-70-C-0230
c07 N72-21186
c07 N72-21193
c09 N72-21264
c13 N72-21387
F19628-70-C-0237
c07 N72-21146
F19628-71-C-0002
c21 N72-21636
F19628-71-C-0072
c20 N72-21600
F30602-68-C-0171
c07 N72-21182
F30602-68-C-0299
c12 N72-21328
F30602-69-C-0112
c07 N72-21167
F30602-69-C-0217
c07 N72-21144
F30602-70-C-0086
c07 N72-21151
F30602-70-C-0161
c09 N72-21263
F30602-70-C-0287
c32 N72-21940
F30602-72-C-0016
c16 N72-21512
F33615-67-C-1027
c03 N72-21037
F33615-68-C-1282
c03 N72-21036
F33615-69-C-1231
c27 N72-21813
F33615-69-C-1265
c15 N72-21499
F33615-69-C-1288
c15 N72-21496
F33615-69-C-1367
c18 N72-21559
F33615-69-C-1385
c18 N72-21561
F33615-69-C-1523
c32 N72-21941
F33615-69-C-1577
c02 N72-21028
F33615-69-C-1606
c17 N72-21554
F33615-70-C-1036
c08 N72-21229
c08 N72-21239
F33615-71-C-1032
c28 N72-21824
F33615-71-C-1143
c18 N72-21565
F33615-71-C-1240
c02 N72-21030
F33657-71-D-0057
c32 N72-21945
F40600-72-C-0003
c14 N72-21461
F41609-69-C-0050
c05 N72-21083
F44620-67-C-0045
c10 N72-21278
c20 N72-21602
c34 N72-21985
F44620-69-C-0039
c07 N72-21181
F44620-69-C-0043
c13 N72-21381
F44620-69-C-0047
c23 N72-21673
F44620-70-C-0105
c14 N72-21456
F44620-70-C-0107
c07 N72-21187
F44620-71-C-0082
c13 N72-21399
F44620-71-C-0091
c04 N72-21061
F61052-69-C-0040
c32 N72-21947
JPL-950897
c15 N72-21478
JPL-952131
c15 N72-21475
MF PROJ. 12.524.005
c02 N72-21016
NASA ORDER C-59718B
c22 N72-21645
NASA ORDER W-12595
c06 N72-21097
NASW-417
c21 N72-21633
c23 N72-21663
NASW-2035
c02 N72-21006
c03 N72-21035
c13 N72-21359
c14 N72-21425
c17 N72-21535
c17 N72-21536
NASW-2037
c04 N72-21042
c04 N72-21046
c13 N72-21360
c14 N72-21413
c14 N72-21414
NASW-2038
c04 N72-21045
c13 N72-21364
c16 N72-21501
c26 N72-21799
c30 N72-21861
c30 N72-21862
c30 N72-21864
c30 N72-21865
c30 N72-21866
c30 N72-21867
c30 N72-21868
c30 N72-21869
NASW-2062
c04 N72-21047
c04 N72-21048
c04 N72-21049
c04 N72-21050
NASW-2088
c18 N72-21555
NASW-2307
c08 N72-21210
NAS1-7522
c14 N72-21420
NAS1-8217
c06 N72-21099
NAS1-8818
c32 N72-21932
NAS1-9398
c14 N72-21415
NAS1-9463
c27 N72-21809
NAS1-10289
c33 N72-21954
NAS1-10653
c21 N72-21625
NAS3-6010
c17 N72-21529
NAS3-9422
c15 N72-21479
NAS3-11167
c17 N72-21534
NAS3-11229
c14 N72-21412
c14 N72-21428
NAS3-14326
c17 N72-21526
NAS3-14405
c22 N72-21647
NAS5-9102
c29 N72-21831
NAS5-9274
c29 N72-21829
NAS5-10260
c06 N72-21105
NAS5-11039
c29 N72-21828
NAS5-11074
c29 N72-21828
NAS5-11477
c28 N72-21820
NAS5-11541
c32 N72-21933
NAS5-21110
c14 N72-21410
NAS5-21600
c31 N72-21895
NAS5-21655
c14 N72-21427
NAS7-100
c07 N72-21154
c07 N72-21155
c11 N72-21281
c14 N72-21411
c15 N72-21474
c15 N72-21475
c15 N72-21478
c26 N72-21791
c31 N72-21891
NAS7-200
c15 N72-21467
c15 N72-21468
NAS7-723
c06 N72-21100
NAS8-4016
c31 N72-21886
c31 N72-21888
c31 N72-21889
NAS8-20081
c15 N72-21482
NAS8-21384
c26 N72-21793
NAS8-21805
c08 N72-21202
NAS8-21810
c30 N72-21870
NAS8-25140
c31 N72-21880
c31 N72-21881
c31 N72-21882
c31 N72-21883
c31 N72-21884
c34 N72-21967
NAS8-26267
c31 N72-21879
NAS8-26578
c30 N72-21857
NAS8-26702
c31 N72-21878
NAS8-26990
c08 N72-21201
NAS8-27088
c13 N72-21365
NAS9-7313
c13 N72-21356
NAS9-7689
c15 N72-21483
NAS9-10416
c08 N72-21206
NAS9-10464
c11 N72-21288
NAS9-10741
c05 N72-21074
NAS9-10858
c14 N72-21426
NAS9-11610
c30 N72-21858
NAS9-11679
c30 N72-21860
NAS9-11778
c08 N72-21203
c08 N72-21204
c08 N72-21205
NAS9-11991
c31 N72-21892
NAS10-6278
c07 N72-21160
NAS12-526
c08 N72-21208
NBS PROJ. 4314561
c11 N72-21305
NELC PROJ. 8207
c07 N72-21175
NGL-16-001-002
c29 N72-21828
NGL-16-001-043
c25 N72-21690
NGL-22-009-124
c07 N72-21120
NGL-26-008-054
c34 N72-21968
NGL-39-011-030
c24 N72-21676
NGL-40-002-015
c19 N72-21568
NGL-44-001-001
c13 N72-21357
c13 N72-21358

NGL-50-002-001
c06 N72-21095
NGR-05-007-003
c25 N72-21693
NGR-05-007-116
c13 N72-21354
NGR-05-007-190
c13 N72-21354
NGR-05-009-079
c24 N72-21675
NGR-06-002-075
c04 N72-21041
NGR-09-015-105
c31 N72-21885
NGR-22-007-211
c29 N72-21829
NGR-22-009-393
c08 N72-21207
NGR-22-009-526
c13 N72-21355
NGR-40-002-094
c26 N72-21798
NONR-4102(01)
c08 N72-21207
NONR-78721
c26 N72-21768
NR PROJ. 012-306
c13 N72-21354
NR PROJ. 033-004
c13 N72-21375
NR PROJ. 041-423
c15 N72-21500
NR PROJ. 042-260
c23 N72-21670
NR PROJ. 042-261
c08 N72-21233
NR PROJ. 044-144
c23 N72-21674
NR PROJ. 047-048
c19 N72-21572
NR PROJ. 056-514
c06 N72-21116
NR PROJ. 064-436
c06 N72-21114
c32 N72-21937
NR PROJ. 083-004
c13 N72-21374
NR PROJ. 089-075
c13 N72-21388
NR PROJ. 092-538
c27 N72-21814
NR PROJ. 145-270
c04 N72-21060
NR PROJ. 154-285
c05 N72-21090
NR PROJ. 196-077
c04 N72-21062
NR PROJ. 196-092
c02 N72-21027
NR PROJ. 260-103
c13 N72-21391
NR PROJ. 263-103
c23 N72-21671
NR PROJ. 319-032
c14 N72-21453
NR PROJ. 375-131
c19 N72-21574
NR PROJ. 384-302
c33 N72-21964
NR PROJ. 388-092
c13 N72-21401
NRL PROJ. G04-01
c04 N72-21068
NSF GA-13885
c13 N72-21386
NSF GB-8412
c04 N72-21073
NSF GJ-1180
c10 N72-21280
NSF GK-475
c26 N72-21774
NSF GK-2224
c26 N72-21773
NSF GK-2645
c07 N72-21120
NSF GK-5433
c23 N72-21674
NSF GK-24485
c19 N72-21568
NSF GK-31633
c08 N72-21232
NSF GP-304
c29 N72-21853
NSF GP-8019
c26 N72-21794
NSF GP-22817
c13 N72-21354
c13 N72-21382
NSF GP-26014
c06 N72-21095
NSF GP-27271
c19 N72-21575
c19 N72-21576
NSF GP-30400
c29 N72-21854
NSF 7198
c26 N72-21719
NSR-09-015-098
c16 N72-21502
N00014-66-C-0032
c26 N72-21805
N00014-66-C-0241
c13 N72-21374
c13 N72-21375
N00014-67-A-0077-0016
c14 N72-21453
N00014-67-A-0094-0019
c29 N72-21853
c29 N72-21854
N00014-67-A-0097-0020
c19 N72-21573
c19 N72-21574
N00014-67-A-0103-0016
c13 N72-21383
N00014-67-A-0108-0027
c26 N72-21803
N00014-67-A-0112-0044
c05 N72-21088
c10 N72-21280
N00014-67-A-0112-0048
c12 N72-21327
N00014-67-A-0197-0001
c04 N72-21056
N00014-67-A-0226-0012
c15 N72-21500
N00014-67-A-0305-0014
c02 N72-21027
c14 N72-21456
N00014-67-A-0305-0015
c08 N72-21240
N00014-67-A-0314-0007
c19 N72-21572
N00014-67-A-0378-0003
c04 N72-21073
N00014-67-A-0385-0010
c32 N72-21946
N00014-67-A-0385-0014
c13 N72-21386
N00014-67-C-0327
c06 N72-21113
N00014-68-A-0109-0004
c23 N72-21667
N00014-68-A-0141-0001
c33 N72-21959
N00014-68-A-0150
c04 N72-21062
N00014-68-A-0158
c08 N72-21230
c16 N72-21507
c26 N72-21804
N00014-68-A-0196-0003
c29 N72-21828
N00014-68-A-0514
c14 N72-21905
N00014-68-A-0515
c23 N72-21670
N00014-69-A-0020-1045
c32 N72-21938
N00014-69-A-0200-1008
c06 N72-21114
c32 N72-21937
N00014-69-A-0200-1015
c13 N72-21377
N00014-69-A-0200-1045
c32 N72-21936
N00014-69-A-0200-4015
c33 N72-21964
N00014-69-A-0200-4022
c23 N72-21674
N00014-69-A-0200-4023
c13 N72-21354
c13 N72-21382
N00014-69-A-0200-6002
c13 N72-21391
N00014-69-A-0200-8010
c06 N72-21116
N00014-69-A-0423
c08 N72-21233
c19 N72-21577
N00014-69-C-0127
c05 N72-21090
N00014-69-C-0151
c13 N72-21401
N00014-69-C-0391
c31 N72-21899
N00014-70-C-0205
c23 N72-21671
N00014-70-C-0320
c13 N72-21384
N00014-70-C-0354
c27 N72-21814
N00014-70-C-0360
c16 N72-21513
N00014-70-C-0361
c11 N72-21306
N00014-71-C-0106
c13 N72-21392
N00014-71-C-0139
c04 N72-21060
N00014-71-C-0183
c23 N72-21666
N00014-71-C-0357
c07 N72-21195
N00014-71-C-0395
c13 N72-21388
N00017-62-C-0604
c07 N72-21196
c20 N72-21622
c21 N72-21639
c26 N72-21807
c34 N72-21986
N00017-72-C-4401
c03 N72-21038
c07 N72-21174
c34 N72-21981
N00140-69-C-0338
c12 N72-21320
N00156-70-C-1100
c15 N72-21493
PAA-72-0040-01
c21 N72-21635
PH-43-68-1455-3
c05 N72-21086
PROJ. MAC
c08 N72-21207
PROJ. THEMIS
c08 N72-21233
c10 N72-21279
SF PROJ. 11-121-301
c16 N72-21505
SF PROJ. 11-552-101
c13 N72-21378
SF PROJ. 35-422-210
c32 N72-21943
SF PROJ. 35-452-007
c32 N72-21944
SF PROJ. 013-03-01
c32 N72-21936
c32 N72-21938
SR PROJ. 104-03-01
c13 N72-21378
SRI PROJ. LSU-8961
c04 N72-21060
SRI PROJ. 4454
c13 N72-21392
SRI PROJ. 7935
c20 N72-21601
T-0260/12630/11013
c13 N72-21373
W-31-109-ENG-38
c22 N72-21657
W-7405-ENG-26
c06 N72-21096
c06 N72-21108
c17 N72-21541
c22 N72-21648
c22 N72-21655
c33 N72-21958
W-7405-ENG-36
c06 N72-21097
c12 N72-21319
c14 N72-21436
W-7405-ENG-48
c12 N72-21318
c25 N72-21695
c30 N72-21872
WF PROJ. 48-222-701
c07 N72-21175
YF38534002
c13 N72-21395
112-02
c13 N72-21361
112-28
c22 N72-21646
113-34
c06 N72-21098
114-03
c15 N72-21470
c17 N72-21532
115-19-02-03
c30 N72-21863
115-23-10-01-51
c23 N72-21661
124-07-11-06-21
c02 N72-21005
132-15
c15 N72-21469
132-80-01-02
c24 N72-21677
134-03
c17 N72-21527
c17 N72-21533
134-03-21-00-21
c17 N72-21537
136-13-05-04
c12 N72-21312
188-36-56-02
c30 N72-21859
607-06-00-01
c20 N72-21589
760-74-01-03
c01 N72-20971
760-74-01-04
c12 N72-21313
760-76-01-04
c01 N72-20970
764-74
c01 N72-20969
914-11-10-EP-72
c31 N72-21887
970-33-10-01
c05 N72-21075

# REPORT/ACCESSION NUMBER INDEX



### Typical Report/Accession Number Index Listing

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A-4131 ..... c02 N72-21005*#
A-4142 ..... c17 N72-21537*#

AADD-184 ..... c11 N72-21301 #

AAR-85 ..... c19 N72-21575 #
AAR-86 ..... c19 N72-21576 #

ACC-72-1 ..... c15 N72-21500 #

ACSI-K-0451 ..... c34 N72-21980 #

AD-728204 ..... c30 N72-21876 #
AD-730826 ..... c13 N72-21354*#
AD-734017 ..... c04 N72-21073 #
AD-734071 ..... c04 N72-21055 #
AD-734118 ..... c04 N72-21056 #
AD-734120 ..... c04 N72-21057 #
AD-734122 ..... c04 N72-21059 #
AD-734126 ..... c04 N72-21058 #
AD-734183 ..... c34 N72-21979 #
AD-734208 ..... c04 N72-21054 #
AD-734255 ..... c07 N72-21167 #
AD-734283 ..... c04 N72-21061 #
AD-734298 ..... c04 N72-21072 #
AD-734376 ..... c29 N72-21854 #
AD-734377 ..... c29 N72-21853 #
AD-734391 ..... c04 N72-21071 #
AD-734419 ..... c13 N72-21374 #
AD-734545L ..... c04 N72-21065 #
AD-734599 ..... c07 N72-21166 #
AD-734658 ..... c18 N72-21559 #
AD-734668 ..... c13 N72-21378 #
AD-734681 ..... c04 N72-21060 #
AD-734755 ..... c08 N72-21229 #
AD-734779 ..... c04 N72-21066 #
AD-734905 ..... c13 N72-21376 #
AD-734919 ..... c30 N72-21875 #
AD-734920 ..... c21 N72-21643 #
AD-734931 ..... c04 N72-21063 #
AD-734933 ..... c04 N72-21064 #
AD-734973 ..... c13 N72-21379 #
AD-734986 ..... c13 N72-21380 #
AD-735051 ..... c05 N72-21080 #
AD-735099 ..... c13 N72-21377 #
AD-735101 ..... c04 N72-21067 #
AD-735114 ..... c13 N72-21375 #
AD-735117 ..... c04 N72-21062 #
AD-735144 ..... c19 N72-21577 #
AD-735145 ..... c08 N72-21233 #
AD-735146 ..... c25 N72-21697 #
AD-735149 ..... c13 N72-21388 #
AD-735150 ..... c17 N72-21551 #
AD-735151 ..... c13 N72-21384 #
AD-735154 ..... c15 N72-21500 #
AD-735163 ..... c06 N72-21116 #
AD-735169 ..... c21 N72-21639 #
AD-735197 ..... c19 N72-21578 #
AD-735204 ..... c02 N72-21019 #
AD-735205 ..... c28 N72-21825 #
AD-735213 ..... c20 N72-21601 #
AD-735223 ..... c34 N72-21984 #
AD-735234 ..... c15 N72-21495 #
AD-735235 ..... c13 N72-21385 #
AD-735238 ..... c18 N72-21562 #
AD-735259 ..... c15 N72-21496 #
AD-735260 ..... c34 N72-21985 #
AD-735261 ..... c20 N72-21602 #
AD-735262 ..... c21 N72-21636 #
AD-735263 ..... c14 N72-21454 #
AD-735265 ..... c07 N72-21177 #
AD-735266 ..... c13 N72-21394 #
AD-735269 ..... c03 N72-21036 #
AD-735270 ..... c15 N72-21499 #
AD-735276 ..... c20 N72-21614 #
AD-735277 ..... c29 N72-21852 #
AD-735278 ..... c18 N72-21561 #
AD-735280 ..... c32 N72-21940 #
AD-735281 ..... c09 N72-21263 #
AD-735282 ..... c23 N72-21668 #
AD-735283 ..... c20 N72-21600 #
AD-735284 ..... c07 N72-21169 #
AD-735286 ..... c15 N72-21494 #
AD-735287 ..... c07 N72-21170 #
AD-735288 ..... c27 N72-21811 #
AD-735289 ..... c28 N72-21826 #
AD-735290 ..... c27 N72-21812 #
AD-735293 ..... c08 N72-21239 #
AD-735294 ..... c02 N72-21030 #
AD-735305 ..... c13 N72-21400 #
AD-735308 ..... c07 N72-21189 #
AD-735314 ..... c17 N72-21552 #
AD-735315 ..... c05 N72-21089 #
AD-735319 ..... c06 N72-21112 #
AD-735323 ..... c23 N72-21672 #
AD-735324 ..... c07 N72-21186 #
AD-735327 ..... c08 N72-21242 #
AD-735329 ..... c09 N72-21270 #
AD-735330 ..... c07 N72-21178 #
AD-735331 ..... c21 N72-21640 #
AD-735334 ..... c16 N72-21511 #
AD-735335 ..... c07 N72-21180 #
AD-735341 ..... c09 N72-21266 #
AD-735342 ..... c09 N72-21267 #
AD-735344 ..... c13 N72-21398 #
AD-735346 ..... c07 N72-21171 #
AD-735348 ..... c10 N72-21279 #
AD-735351 ..... c02 N72-21029 #
AD-735354 ..... c20 N72-21621 #
AD-735355 ..... c20 N72-21620 #
AD-735356 ..... c20 N72-21619 #
AD-735357 ..... c20 N72-21618 #
AD-735358 ..... c20 N72-21617 #
AD-735359 ..... c20 N72-21607 #
AD-735360 ..... c20 N72-21608 #
AD-735361 ..... c20 N72-21595 #
AD-735362 ..... c20 N72-21597 #
AD-735363 ..... c15 N72-21498 #
AD-735364 ..... c20 N72-21596 #
AD-735366 ..... c23 N72-21673 #
AD-735369 ..... c15 N72-21491 #
AD-735372 ..... c21 N72-21635 #
AD-735375 ..... c02 N72-21013 #
AD-735377 ..... c05 N72-21082 #
AD-735381 ..... c28 N72-21823 #
AD-735383 ..... c12 N72-21321 #
AD-735386 ..... c13 N72-21381 #
AD-735393 ..... c20 N72-21603 #
AD-735396 ..... c26 N72-21806 #
AD-735408 ..... c34 N72-21989 #
AD-735418 ..... c11 N72-21305 #
AD-735420 ..... c02 N72-21014 #
AD-735425 ..... c34 N72-21980 #
AD-735434 ..... c18 N72-21560 #
AD-735435 ..... c09 N72-21260 #
AD-735436 ..... c15 N72-21492 #
AD-735437 ..... c17 N72-21546 #

AD-735439 ..... c01 N72-20973 #
AD-735441 ..... c20 N72-21594 #
AD-735448 ..... c13 N72-21395 #
AD-735451 ..... c04 N72-21068 #
AD-735457 ..... c02 N72-21016 #
AD-735459 ..... c16 N72-21505 #
AD-735462 ..... c05 N72-21081 #
AD-735463 ..... c16 N72-21506 #
AD-735466 ..... c17 N72-21548 #
AD-735467 ..... c17 N72-21547 #
AD-735468 ..... c20 N72-21593 #
AD-735471 ..... c12 N72-21320 #
AD-735472 ..... c02 N72-21015 #
AD-735475 ..... c19 N72-21572 #
AD-735480 ..... c25 N72-21696 #
AD-735481 ..... c19 N72-21574 #
AD-735482 ..... c19 N72-21573 #
AD-735483 ..... c06 N72-21113 #
AD-735488 ..... c31 N72-21899 #
AD-735491 ..... c11 N72-21306 #
AD-735492 ..... c33 N72-21959 #
AD-735495 ..... c34 N72-21988 #
AD-735498 ..... c09 N72-21262 #
AD-735500 ..... c09 N72-21261 #
AD-735501 ..... c14 N72-21453 #
AD-735507 ..... c34 N72-21981 #
AD-735510 ..... c06 N72-21115 #
AD-735514 ..... c13 N72-21386 #
AD-735582 ..... c33 N72-21961 #
AD-735604 ..... c12 N72-21322 #
AD-735605 ..... c21 N72-21637 #
AD-735621 ..... c09 N72-21269 #
AD-735640 ..... c14 N72-21455 #
AD-735651 ..... c10 N72-21278 #
AD-735653 ..... c07 N72-21179 #
AD-735654 ..... c07 N72-21183 #
AD-735655 ..... c01 N72-20974 #
AD-735660 ..... c15 N72-21497 #
AD-735661 ..... c09 N72-21264 #
AD-735662 ..... c05 N72-21087 #
AD-735664 ..... c13 N72-21397 #
AD-735665 ..... c16 N72-21508 #
AD-735667 ..... c02 N72-21012 #
AD-735674 ..... c16 N72-21510 #
AD-735679 ..... c07 N72-21172 #
AD-735680 ..... c21 N72-21638 #
AD-735682 ..... c07 N72-21173 #
AD-735683 ..... c32 N72-21939 #
AD-735685 ..... c26 N72-21808 #
AD-735686 ..... c07 N72-21168 #
AD-735687 ..... c18 N72-21564 #
AD-735690 ..... c19 N72-21579 #
AD-735697 ..... c12 N72-21323 #
AD-735700 ..... c17 N72-21550 #
AD-735704 ..... c12 N72-21325 #
AD-735710 ..... c17 N72-21549 #
AD-735713 ..... c08 N72-21232 #
AD-735721 ..... c28 N72-21824 #
AD-735722 ..... c33 N72-21962 #
AD-735723 ..... c07 N72-21182 #
AD-735724 ..... c20 N72-21616 #
AD-735726 ..... c32 N72-21941 #
AD-735727 ..... c13 N72-21387 #
AD-735728 ..... c08 N72-21234 #
AD-735729 ..... c08 N72-21235 #
AD-735730 ..... c08 N72-21236 #
AD-735731 ..... c08 N72-21237 #
AD-735732 ..... c08 N72-21238 #
AD-735733 ..... c02 N72-21028 #
AD-735736 ..... c03 N72-21037 #
AD-735737 ..... c20 N72-21610 #
AD-735738 ..... c20 N72-21613 #
AD-735739 ..... c20 N72-21612 #
AD-735740 ..... c20 N72-21611 #
AD-735742 ..... c20 N72-21606 #
AD-735749 ..... c08 N72-21241 #
AD-735752 ..... c07 N72-21188 #
AD-735755 ..... c09 N72-21268 #
AD-735758 ..... c07 N72-21187 #
AD-735760 ..... c07 N72-21181 #
AD-735761 ..... c12 N72-21326 #
AD-735765 ..... c13 N72-21399 #
AD-735787 ..... c19 N72-21580 #
AD-735788 ..... c14 N72-21460 #
AD-735791 ..... c20 N72-21615 #
AD-735792 ..... c32 N72-21942 #
AD-735799 ..... c05 N72-21083 #
AD-735814 ..... c26 N72-21807 #
AD-735830 ..... c23 N72-21669 #
AD-735859 ..... c23 N72-21670 #
AD-735864 ..... c03 N72-21038 #
AD-735866 ..... c07 N72-21174 #
AD-735868 ..... c07 N72-21175 #
AD-735869 ..... c34 N72-21986 #
AD-735871 ..... c13 N72-21389 #
AD-735872 ..... c22 N72-21659 #
AD-735873 ..... c32 N72-21944 #
AD-735874 ..... c32 N72-21943 #
AD-735875 ..... c12 N72-21324 #
AD-735876 ..... c18 N72-21563 #
AD-735877 ..... c33 N72-21963 #
AD-735878 ..... c16 N72-21509 #
AD-735881 ..... c04 N72-21069 #
AD-735882 ..... c05 N72-21084 #
AD-735885 ..... c23 N72-21671 #
AD-735886 ..... c07 N72-21176 #
AD-735896 ..... c20 N72-21605 #
AD-735897 ..... c34 N72-21987 #
AD-735898 ..... c13 N72-21393 #
AD-735900 ..... c05 N72-21088 #
AD-735901 ..... c10 N72-21280 #
AD-735903 ..... c08 N72-21240 #
AD-735915 ..... c02 N72-21027 #
AD-735916 ..... c14 N72-21456 #
AD-735917 ..... c13 N72-21392 #
AD-735919 ..... c07 N72-21184 #
AD-735921 ..... c07 N72-21185 #
AD-735922 ..... c12 N72-21327 #
AD-735923 ..... c32 N72-21946 #
AD-735924 ..... c33 N72-21964 #
AD-735925 ..... c32 N72-21945 #
AD-735927 ..... c32 N72-21937 #
AD-735928 ..... c06 N72-21114 #
AD-735931 ..... c13 N72-21391 #
AD-735934 ..... c13 N72-21382 #
AD-735936 ..... c32 N72-21936 #
AD-735937 ..... c32 N72-21938 #
AD-735939 ..... c16 N72-21507 #
AD-735941 ..... c20 N72-21604 #
AD-735942 ..... c05 N72-21085 #
AD-735944 ..... c26 N72-21805 #
AD-735945 ..... c23 N72-21667 #
AD-735946 ..... c08 N72-21230 #
AD-735947 ..... c26 N72-21804 #
AD-735951 ..... c23 N72-21666 #
AD-735953 ..... c15 N72-21493 #
AD-735954 ..... c14 N72-21459 #
AD-735956 ..... c26 N72-21803 #
AD-735957 ..... c13 N72-21383 #
AD-735962 ..... c34 N72-21982 #
AD-735967 ..... c11 N72-21307 #
AD-735970 ..... c21 N72-21641 #
AD-735995 ..... c13 N72-21390 #
AD-736016 ..... c03 N72-21040 #
AD-736017 ..... c14 N72-21461 #
AD-736029 ..... c07 N72-21193 #
AD-736037 ..... c16 N72-21512 #
AD-736039 ..... c17 N72-21553 #
AD-736040 ..... c12 N72-21328 #
AD-736044 ..... c32 N72-21947 #
AD-736094 ..... c02 N72-21031 #
AD-736115 ..... c07 N72-21192 #
AD-736150 ..... c07 N72-21196 #
AD-736152 ..... c20 N72-21622 #
AD-736212 ..... c05 N72-21090 #
AD-736221 ..... c07 N72-21195 #
AD-736222 ..... c27 N72-21814 #
AD-736223 ..... c16 N72-21513 #
AD-736224 ..... c13 N72-21401 #
AD-736429 ..... c07 N72-21194 #
AD-736430 ..... c29 N72-21855 #
AD-736431 ..... c13 N72-21403 #
AD-736470 ..... c18 N72-21565 #
AD-736475 ..... c27 N72-21813 #
AD-736481 ..... c13 N72-21402 #
AD-736483 ..... c25 N72-21698 #
AD-736484 ..... c17 N72-21554 #
AD-736485 ..... c20 N72-21623 #
AD-736489 ..... c28 N72-21827 #
AD-736533 ..... c09 N72-21271 #
AD-736535 ..... c09 N72-21272 #
AD-736537 ..... c02 N72-21032 #
AD-736630 ..... c23 N72-21674 #
AD-765681 ..... c08 N72-21231 #

AEC-TR-7268 ..... c13 N72-21370 #
AEC-TR-7287 ..... c17 N72-21544 #
AEC-TR-7289 ..... c17 N72-21543 #

AECL-4059 ..... c29 N72-21850 #
AECL-4060 ..... c29 N72-21849 #

AED-R-3689 ..... c31 N72-21895*#

AEDC-TR-71-265 ..... c14 N72-21461 #

AERE-R-6910 ..... c13 N72-21368 #

AEWES-MISC-PAPER-S-71-27 ..... c13 N72-21398 #

AFAPL-TR-71-11 ..... c15 N72-21497 #
AFAPL-TR-71-32 ..... c03 N72-21040 #
AFAPL-TR-71-40 ..... c03 N72-21037 #
AFAPL-TR-71-71 ..... c15 N72-21496 #
AFAPL-TR-71-82 ..... c03 N72-21036 #
AFAPL-TR-71-85 ..... c15 N72-21499 #
AFAPL-TR-71-98 ..... c27 N72-21813 #

AFATL-TR-71-69 ..... c01 N72-20974 #

AFCRL-ERP-360 ..... c07 N72-21177 #
AFCRL-ERP-366 ..... c13 N72-21394 #

AFCRL-PSRP-462 ..... c07 N72-21179 #

AFCRL-71-0248 ..... c07 N72-21169 #
AFCRL-71-0371 ..... c07 N72-21177 #
AFCRL-71-0404 ..... c20 N72-21600 #
AFCRL-71-0411 ..... c13 N72-21394 #
AFCRL-71-0428 ..... c07 N72-21179 #
AFCRL-71-0470 ..... c29 N72-21852 #
AFCRL-71-0503 ..... c07 N72-21170 #

AFETR-TR-71-5 ..... c14 N72-21454 #

AFFDL-TR-71-52-VOL-1 ..... c08 N72-21229 #
AFFDL-TR-71-52-VOL-3 ..... c08 N72-21239 #
AFFDL-TR-71-54 ..... c32 N72-21941 #
AFFDL-TR-71-62-VOL-4-PT-2 ..... c02 N72-21028 #
AFFDL-TR-71-1906 ..... c02 N72-21030 #

AFGWC-TN-71-3 ..... c20 N72-21606 #
AFGWC-TN-71-6 ..... c20 N72-21610 #
AFGWC-TN-71-7 ..... c20 N72-21613 #
AFGWC-TN-71-9 ..... c20 N72-21611 #

AFIT-TR-71-4 ..... c12 N72-21326 #

AFML-TR-68-311-PT-4 ..... c18 N72-21559 #
AFML-TR-71-132 ..... c18 N72-21561 #
AFML-TR-71-160 ..... c18 N72-21565 #
AFML-TR-71-241 ..... c17 N72-21554 #

AFOSR-71-0006TR..... c14 N72-21456 #
AFOSR-71-2366TR ..... c12 N72-21321 #
AFOSR-71-2584TR ..... c17 N72-21553 #
AFOSR-71-2633TR ..... c04 N72-21061 #
AFOSR-71-2692TR ..... c19 N72-21578 #
AFOSR-71-2695TR ..... c23 N72-21673 #
AFOSR-72-0083TR ..... c13 N72-21381 #
AFOSR-72-0085TR ..... c26 N72-21806 #
AFOSR-72-0088TR ..... c34 N72-21984 #
AFOSR-72-0141TR ..... c07 N72-21181 #
AFOSR-72-0142TR ..... c07 N72-21187 #
AFOSR-72-0232TR ..... c32 N72-21947 #
AFOSR-72-0158TR ..... c13 N72-21399 #

AFRPL-TR-71-84 ..... c15 N72-21494 #
AFRPL-TR-71-107 ..... c28 N72-21824 #
AFRPL-TR-71-109 ..... c33 N72-21962 #
AFRPL-TR-71-113 ..... c27 N72-21811 #
AFRPL-TR-71-116 ..... c28 N72-21826 #
AFRPL-TR-71-117 ..... c27 N72-21812 #

AGARD-AG-158 ..... c08 N72-21211 #

AGARD-AR-40 ..... c20 N72-21590 #
AGARD-AR-41 ..... c28 N72-21819*#

AGARD-BULL-72-1 ..... c34 N72-21973 #

AGARD-CP-85 ..... c02 N72-20976 #
AGARD-CP-97 ..... c07 N72-21121 #
AGARD-CP-98 ..... c32 N72-21900 #

AGARDOGRAPH-158 ..... c08 N72-21211 #

AM-71-5 ..... c32 N72-21937 #
AM-71-6 ..... c06 N72-21114 #

AMMRC-TR-71-48 ..... c17 N72-21552 #

AMRL-TR-71-4 ..... c04 N72-21065 #
AMRL-TR-71-102 ..... c05 N72-21089 #
AMRL-TR-71-112 ..... c04 N72-21055 #

AMS-1014 ..... c28 N72-21823 #
AMS-1018 ..... c17 N72-21550 #

AMSWE-CPE-71-11 ..... c34 N72-21988 #

ANCR-1032 ..... c22 N72-21645*#

ANL-7839 ..... c22 N72-21657 #

APGWC-TN-71-8 ..... c20 N72-21612 #

APL-CLB-3-T-637 ..... c26 N72-21807 #
APL-CLB-3-T-639 ..... c34 N72-21981 #

APL-TG-1157 ..... c07 N72-21196 #
APL-TG-1165 ..... c20 N72-21622 #
APL-TG-1176 ..... c03 N72-21038 #
APL-TG-1182 ..... c07 N72-21174 #

APL-U-RQR/71-1 ..... c34 N72-21986 #

APL-U-SQR/71-2 ..... c21 N72-21639 #

APL/JHU-TPR-018 ..... c34 N72-21983 #

APTD-0797 ..... c09 N72-21259 #
APTD-0846 ..... c20 N72-21598 #
APTD-0849 ..... c02 N72-21018 #
APTD-0850 ..... c02 N72-21017 #
APTD-0865 ..... c14 N72-21458 #
APTD-0870 ..... c14 N72-21457 #
APTD-0875 ..... c03 N72-21039 #

ARDG(E)-E-1346-PT-2-ADD ..... c07 N72-21166 #

ARL-71-0015 ..... c02 N72-21027 #
ARL-71-0020 ..... c14 N72-21456 #

ARO-VKF-TR-71-212 ..... c14 N72-21461 #

AROD-T-1-82-RT ..... c15 N72-21498 #

AROD-71-4 ..... c19 N72-21579 #
AROD-6784-2-EN ..... c20 N72-21603 #
AROD-8090-7-E ..... c17 N72-21550 #
AROD-8127-2-E ..... c12 N72-21323 #

ASR-1 ..... c04 N72-21060 #

A6145 ..... c26 N72-21805 #

BATT-8917-F ..... c03 N72-21036 #

BBN-2272 ..... c05 N72-21090 #

BDX-613-472 ..... c09 N72-21256 #

BEC-2064QR2 ..... c14 N72-21427*#

BM-RI-7577-PT-2 ..... c30 N72-21877 #

BNL-TR-447 ..... c11 N72-21303 #
BNL-TR-458 ..... c33 N72-21957 #

BNL-16276 ..... c17 N72-21540 #
BNL-16299 ..... c11 N72-21301 #
BNL-16326 ..... c06 N72-21107 #
BNL-16327 ..... c06 N72-21106 #

BNWL-SA-3936 ..... c14 N72-21441 #

BR-28525 ..... c32 N72-21934 #
BR-28526 ..... c04 N72-21051 #
BR-28527 ..... c10 N72-21273 #

CAL-BM-3053-F-1 ..... c02 N72-21030 #

CEA-CONF-1840 ..... c14 N72-21439 #

CEA-M-1491 ..... c09 N72-21257 #

CERN-71-15 ..... c24 N72-21681 #

CONF-680733 ..... c13 N72-21370 #
CONF-710816-2 ..... c24 N72-21680 #
CONF-710903-6 ..... c22 N72-21652 #
CONF-710937-1 ..... c14 N72-21439 #
CONF-711108-4 ..... c17 N72-21540 #
CONF-711108-7 ..... c06 N72-21106 #
CONF-711108-8 ..... c06 N72-21107 #
CONF-711111-12 ..... c14 N72-21441 #
CONF-711113-2 ..... c22 N72-21658 #
CONF-711113-3 ..... c22 N72-21653 #
CONF-711118-1 ..... c19 N72-21571 #
CONF-720103-1 ..... c16 N72-21504 #

CRES-TR-133-24 ..... c07 N72-21188 #

CRISP-71-41 ..... c11 N72-21301 #

CT-43 ..... c19 N72-21574 #
CT-47 ..... c19 N72-21573 #

DLR-FB-71-62 ..... c12 N72-21315 #
DLR-FB-71-64 ..... c19 N72-21569 #
DLR-FB-71-65 ..... c04 N72-21053 #
DLR-FB-71-69 ..... c12 N72-21316 #
DLR-FB-71-97 ..... c12 N72-21317 #

DLR-MITT-71-26 ..... c28 N72-21822 #

DMS-DR-1102 ..... c31 N72-21886*#
DMS-DR-1223 ..... c31 N72-21888*#
DMS-DR-1240 ..... c31 N72-21889*#

DNA-2730F ..... c09 N72-21262 #
DNA-2738T ..... c04 N72-21054 #
DNA-2786T ..... c25 N72-21697 #

DOC-70SD5414 ..... c05 N72-21074*#

DOT-TSC-CG-71-1 ..... c14 N72-21452 #
DOT-TSC-CG-71-3 ..... c14 N72-21451 #

DOT-TSC-FAA-71-7 ..... c21 N72-21626 #
DOT-TSC-FAA-71-13 ..... c21 N72-21629 #
DOT-TSC-FAA-71-18 ..... c02 N72-21000 #
DOT-TSC-FAA-71-25 ..... c02 N72-20998 #
DOT-TSC-FAA-71-26 ..... c21 N72-21628 #
DOT-TSC-FAA-71-27 ..... c02 N72-20997 #
DOT-TSC-FAA-71-29 ..... c21 N72-21627 #
DOT-TSC-FAA-72-8 ..... c21 N72-21630 #
DOT-TSC-FAA-72-13 ..... c02 N72-20999 #

DOT-TSC-FHWA-71-1 ..... c14 N72-21450 #

DOT-TSC-NHSB-71-1 ..... c14 N72-21448 #

DOT-TSC-NHTSA-71-3 ..... c14 N72-21449 #
DOT-TSC-NHTSA-71-4 ..... c14 N72-21447 #

DOT-TSC-OST-71-5 ..... c20 N72-21592 #
DOT-TSC-OST-71-8 ..... c07 N72-21165 #
DOT-TSC-OST-71-11 ..... c34 N72-21977 #
DOT-TSC-OST-71-12 ..... c21 N72-21634 #
DOT-TSC-OST-71-17 ..... c34 N72-21978 #

DP-1175 ..... c14 N72-21443 #

DR-674 ..... c20 N72-21621 #
DR-675 ..... c20 N72-21620 #
DR-676 ..... c20 N72-21619 #
DR-677 ..... c20 N72-21618 #
DR-678 ..... c20 N72-21617 #
DR-679 ..... c20 N72-21596 #
DR-680 ..... c20 N72-21607 #
DR-682 ..... c20 N72-21608 #
DR-683 ..... c20 N72-21595 #
DR-684 ..... c20 N72-21597 #

D213-10000-VOL-4-PT-2 ..... c02 N72-21028 #

E-6390 ..... c22 N72-21646*#
E-6644 ..... c01 N72-20969*#
E-6688 ..... c28 N72-21817*#
E-6701 ..... c13 N72-21361*#
E-6713 ..... c15 N72-21469*#
E-6741 ..... c06 N72-21098*#
E-6766 ..... c17 N72-21532*#
E-6767 ..... c15 N72-21470*#
E-6791 ..... c17 N72-21533*#
E-6793 ..... c17 N72-21527*#
E-6834 ..... c17 N72-21525*#
E-6848 ..... c28 N72-21816*#
E-6859 ..... c03 N72-21033*#
E-6861 ..... c03 N72-21034*#
E-6867 ..... c33 N72-21953*#
E-6871 ..... c12 N72-21311*#
E-6873 ..... c11 N72-21287*#
E-6880 ..... c28 N72-21815*#
E-6881 ..... c33 N72-21952*#

ECOM-0145-F ..... c09 N72-21268 #
ECOM-0273-4 ..... c23 N72-21672 #
ECOM-0290-9 ..... c09 N72-21267 #
ECOM-3440 ..... c08 N72-21242 #
ECOM-3481 ..... c09 N72-21270 #
ECOM-3489 ..... c07 N72-21172 #
ECOM-3503 ..... c16 N72-21511 #
ECOM-3504 ..... c07 N72-21178 #
ECOM-3510 ..... c21 N72-21640 #
ECOM-3512 ..... c07 N72-21180 #
ECOM-3514 ..... c21 N72-21638 #
ECOM-3516 ..... c08 N72-21231 #
ECOM-3518 ..... c07 N72-21173 #
ECOM-3524 ..... c26 N72-21808 #
ECOM-5412 ..... c07 N72-21168 #
ECOM-02411-24 ..... c07 N72-21171 #

EE-186(71)ONR-005 ..... c16 N72-21507 #
EE-187(71)ONR-005 ..... c08 N72-21230 #
EE-193(71)ONR-005 ..... c26 N72-21804 #

EIR-184 ..... c17 N72-21544 #

ELR-1509 ..... c20 N72-21599 #

EPIC-IR-15 ..... c09 N72-21269 #

ESD-TR-71-199 ..... c13 N72-21387 #
ESD-TR-71-271 ..... c09 N72-21264 #
ESD-TR-71-272 ..... c07 N72-21193 #
ESD-TR-71-318 ..... c07 N72-21186 #
ESD-TR-71-362 ..... c21 N72-21636 #
ESD-TR-71-370-VOL-1 ..... c08 N72-21234 #
ESD-TR-71-370-VOL-2 ..... c08 N72-21235 #
ESD-TR-71-370-VOL-3 ..... c08 N72-21236 #
ESD-TR-71-370-VOL-4 ..... c08 N72-21237 #
ESD-TR-71-370-VOL-5 ..... c08 N72-21238 #

ESL-P-473 ..... c07 N72-21120*#

ESL-2738-4 ..... c07 N72-21167 #
ESL-3271-1 ..... c16 N72-21512 #

ESRO-CR(P)-74 ..... c07 N72-21163 #

ESRO-CR-46 ..... c07 N72-21164 #

ESRO-SM-80 ..... c14 N72-21444 #

ESRO-SP-64 ..... c11 N72-21291 #
ESRO-SP-66 ..... c11 N72-21296 #

ESRO-SR-13 ..... c30 N72-21873 #
ESRO-SR-15 ..... c30 N72-21874 #

ESRO-TM-105-ESTEC ..... c09 N72-21258 #

ETL-CR-71-21 ..... c07 N72-21188 #
ETL-CR-71-22 ..... c15 N72-21491 #

ETM-179-VOL-1 ..... c09 N72-21259 #

ETR-TR-71-6 ..... c21 N72-21635 #

FAA-AM-72-3 ..... c05 N72-21077 #
FAA-AM-72-6 ..... c05 N72-21078 #

FAA-NA-72-7 ..... c05 N72-21085 #

FAA-RD-71-52 ..... c20 N72-21601 #
FAA-RD-71-102 ..... c20 N72-21604 #
FAA-RD-71-106 ..... c05 N72-21085 #

FR-9184 ..... c07 N72-21189 #

FRA-RT-72-25 ..... c09 N72-21265 #

FRNC-TH-70 ..... c11 N72-21302 #
FRNC-TH-75 ..... c25 N72-21694 #

FSC-F/195 ..... c07 N72-21182 #

FSC-72-5010 ..... c05 N72-21081 #

FSTC-HT-23-673-71 ..... c18 N72-21560 #
FSTC-HT-23-677-71 ..... c15 N72-21495 #
FSTC-HT-23-678-71 ..... c17 N72-21546 #
FSTC-HT-23-707-71 ..... c01 N72-20973 #
FSTC-HT-23-737-71 ..... c13 N72-21402 #
FSTC-HT-23-903-72 ..... c34 N72-21980 #
FSTC-HT-23-1037-71 ..... c09 N72-21260 #
FSTC-HT-23-1173-71 ..... c15 N72-21492 #
FSTC-HT-23-1281-71 ..... c13 N72-21385 #

FTAS/TR-71-67 ..... c12 N72-21321 #

FTC-TIM-71-1001 ..... c02 N72-21007 #

FTD-HC-23-739-71 ..... c32 N72-21945 #
FTD-HC-23-862-71 ..... c28 N72-21825 #
FTD-HC-23-880-71 ..... c21 N72-21643 #
FTD-HC-23-979-71 ..... c16 N72-21506 #

FTD-HT-23-21-71 ..... c02 N72-21019 #
FTD-HT-23-911-71 ..... c25 N72-21696 #
FTD-HT-23-991-71 ..... c12 N72-21322 #
FTD-HT-23-1057-71 ..... c21 N72-21637 #
FTD-HT-23-1140-71 ..... c18 N72-21562 #
FTD-HT-23-1310-71 ..... c14 N72-21455 #
FTD-HT-23-1342-71 ..... c17 N72-21548 #

FTD-MT-24-117-71 ..... c17 N72-21547 #
FTD-MT-24-275-70 ..... c33 N72-21961 #
FTD-MT-24-987-71 ..... c25 N72-21698 #
FTD-MT-24-1399-71 ..... c30 N72-21875 #
FTD-MT-24-1403-71 ..... c20 N72-21593 #
FTD-MT-24-1411-71 ..... c20 N72-21623 #
FTD-MT-24-1414-71 ..... c13 N72-21376 #
FTD-MT-24-1453-71 ..... c28 N72-21827 #

G-0000 ..... c23 N72-21661*#

GARP-SPEC-5 ..... c20 N72-21591 #

GDC-BNZ70-013-18 ..... c27 N72-21812 #

GER-15491 ..... c11 N72-21306 #

GESP-459-PT-1 ..... c15 N72-21479*#

GNE/PH/71-4 ..... c07 N72-21183 #

GRC-RM-1545 ..... c25 N72-21697 #

GSM/SM/71-2 ..... c02 N72-21029 #

GT-8747-R ..... c02 N72-21018 #

HDL-TM-71-35 ..... c12 N72-21325 #

HDL-TR-1563 ..... c06 N72-21112 #
HDL-TR-1566 ..... c09 N72-21266 #

HEDL-TME-71-118 ..... c15 N72-21490 #

HPR-143 ..... c22 N72-21650 #

HREC-6578-1 ..... c30 N72-21857*#

HTL-105 ..... c33 N72-21959 #

HUNSRO-PP-17-71 ..... c05 N72-21080 #

ICT-10/70 ..... c27 N72-21810 #

ID-71D ..... c34 N72-21990 #

IDA-LOG-HQ-69-10164 ..... c11 N72-21290 #

IITRI-V6026-FR ..... c26 N72-21805 #

IPPJ-119 ..... c25 N72-21692 #

IRI-133-71-17 ..... c06 N72-21111 #

ISL-4/71 ..... c11 N72-21304 #
ISL-6/71 ..... c13 N72-21373 #
ISL-7/70 ..... c14 N72-21446 #

JPL-TM-33-525 ..... c14 N72-21411*#
JPL-TM-33-531 ..... c31 N72-21891*#

JPL-TR-32-1548 ..... c07 N72-21154*#
JPL-TR-32-1554 ..... c11 N72-21281*#

JPRS-55392 ..... c17 N72-21517 #
JPRS-55553 ..... c04 N72-21044 #
JPRS-55554 ..... c17 N72-21530 #
JPRS-55555 ..... c28 N72-21818 #
JPRS-55556 ..... c17 N72-21531 #
JPRS-55618 ..... c07 N72-21156 #
JPRS-55687 ..... c04 N72-21043 #

KGO-TR-71-105 ..... c14 N72-21445 #

KGO-721 ..... c23 N72-21665 #

K2.030 ..... c09 N72-21263 #

L-7898 ..... c30 N72-21863*#
L-8037 ..... c12 N72-21312*#
L-8092 ..... c01 N72-20971*#
L-8099 ..... c05 N72-21075*#
L-8104 ..... c01 N72-20970*#
L-8111 ..... c30 N72-21859*#
L-8159 ..... c12 N72-21313*#
L-8176 ..... c24 N72-21677*#
L-8205 ..... c20 N72-21589*#

LA-4754 ..... c12 N72-21319 #
LA-4773-PT-1 ..... c14 N72-21436 #
LA-4917-PR ..... c06 N72-21097*#

LAL-1256 ..... c24 N72-21680 #

LCR-DR-70-90/1/R ..... c23 N72-21664 #

LMSC-4-05-71-C ..... c13 N72-21384 #

LMSC/HREC-D225368 ..... c30 N72-21857*#

LSC-15 ..... c04 N72-21073 #

LTI-737-13283 ..... c06 N72-21091

MAC-TR-87 ..... c08 N72-21207*#

MASC-215F ..... c32 N72-21933*#

MBB-BB-55-71-0 ..... c02 N72-21011 #

MCR-71-233 ..... c33 N72-21954*#

MDC-G2078 ..... c18 N72-21565 #
MDC-G2529 ..... c33 N72-21962 #
MDC-G2582-VOL-1-SECT-1-4.4 ..... c31 N72-21880*#
MDC-G2582-VOL-2-SECT-4.5-4.8 ..... c31 N72-21881*#
MDC-G2582-VOL-3 ..... c31 N72-21882*#
MDC-G2584-VOL-2-APP ..... c34 N72-21967*#
MDC-G2595 ..... c31 N72-21883*#
MDC-G2596 ..... c31 N72-21884*#
MDC-G2744 ..... c17 N72-21554 #
MDC-G2835 ..... c31 N72-21879*#

MJO-3004-PT-4 ..... c18 N72-21559 #

MLM-1828 ..... c06 N72-21109 #
MLM-1861 ..... c06 N72-21110 #

MNC-3783-10 ..... c14 N72-21442 #

MPL-U-47/1 ..... c13 N72-21391 #

MR-S-1017 ..... c15 N72-21494 #

MSC-S-315 ..... c31 N72-21887*#

MSC-1636 ..... c14 N72-21453 #
MSC-01500 ..... c11 N72-21288*#

MSFC-DPD-235/DR-SE-10 ..... c31 N72-21884*#

MTR-2143 ..... c21 N72-21636 #

NADC-AE-7112 ..... c07 N72-21176 #

NADC-CS-7104 ..... c04 N72-21069 #
NADC-CS-7110 ..... c05 N72-21084 #

NADC-ST-7101 ..... c02 N72-21015 #

NAE-LR-549 ..... c02 N72-21014 #
NAE-LR-553 ..... c11 N72-21307 #

NAEC-ENG-7707 ..... c33 N72-21963 #

NAMRL-1141 ..... c04 N72-21067 #
NAMRL-1145 ..... c02 N72-21016 #

NASA-CASE-ARC-10097-2 ..... c07 N72-21161*#
NASA-CASE-ARC-10176-1 ..... c15 N72-21464*
NASA-CASE-ARC-10192 ..... c09 N72-21245*
NASA-CASE-ARC-10278-1 ..... c14 N72-21434*#
NASA-CASE-ARC-10302-1 ..... c04 N72-21052*#
NASA-CASE-ARC-10329-1 ..... c05 N72-21079*#
NASA-CASE-ARC-10344-1 ..... c14 N72-21433*#
NASA-CASE-ARC-10364-1 ..... c10 N72-21276*#
NASA-CASE-ARC-10448-1 ..... c14 N72-21421*#
NASA-CASE-ARC-10464-1 ..... c06 N72-21102*#
NASA-CASE-ARC-10467-1 ..... c09 N72-21249*#
NASA-CASE-ARC-10470-1 ..... c02 N72-21010*#

NASA-CASE-ERC-10087-2 ..... c14 N72-21430*#
NASA-CASE-ERC-10108 ..... c06 N72-21094*
NASA-CASE-ERC-10112 ..... c07 N72-21119*
NASA-CASE-ERC-10119 ..... c26 N72-21701*
NASA-CASE-ERC-10224-2 ..... c09 N72-21253*#
NASA-CASE-ERC-10226-2 ..... c02 N72-21008*#
NASA-CASE-ERC-10307 ..... c08 N72-21198*
NASA-CASE-ERC-10419 ..... c21 N72-21631*#

NASA-CASE-FRC-10049-1 ..... c21 N72-21632*#

NASA-CASE-GSC-10218-1 ..... c15 N72-21465*
NASA-CASE-GSC-11262-1 ..... c16 N72-21503*#
NASA-CASE-GSC-11296-1 ..... c23 N72-21662*#
NASA-CASE-GSC-11302-1 ..... c14 N72-21435*#
NASA-CASE-GSC-11304-1 ..... c06 N72-21105*#
NASA-CASE-GSC-11444-1 ..... c14 N72-21418*#

NASA-CASE-HQN-10439 ..... c21 N72-21624*
NASA-CASE-HQN-10542-1 ..... c23 N72-21663*#
NASA-CASE-HQN-10654-1 ..... c16 N72-21502*#

NASA-CASE-KSC-10326 ..... c08 N72-21197*
NASA-CASE-KSC-10393 ..... c09 N72-21247*
NASA-CASE-KSC-10521-1 ..... c07 N72-21160*#
NASA-CASE-KSC-10622-1 ..... c31 N72-21893*#
NASA-CASE-KSC-10644-1 ..... c09 N72-21250*#
NASA-CASE-KSC-10698-1 ..... c07 N72-21159*#

NASA-CASE-LAR-10170-1 ..... c15 N72-21471*#
NASA-CASE-LAR-10195-1 ..... c15 N72-21488*#
NASA-CASE-LAR-10241-1 ..... c05 N72-21076*#
NASA-CASE-LAR-10295-1 ..... c15 N72-21472*#
NASA-CASE-LAR-10310-1 ..... c10 N72-21275*#
NASA-CASE-LAR-10319-1 ..... c14 N72-21423*#
NASA-CASE-LAR-10439-1 ..... c33 N72-21956*#
NASA-CASE-LAR-10440-1 ..... c14 N72-21420*#
NASA-CASE-LAR-10489-1 ..... c15 N72-21484*#
NASA-CASE-LAR-10503-1 ..... c09 N72-21248*#
NASA-CASE-LAR-10544-1 ..... c15 N72-21477*#
NASA-CASE-LAR-10545-1 ..... c09 N72-21244*
NASA-CASE-LAR-10551-1 ..... c06 N72-21099*#
NASA-CASE-LAR-10623-1 ..... c14 N72-21415*#
NASA-CASE-LAR-10626-1 ..... c14 N72-21416*#
NASA-CASE-LAR-10634-1 ..... c15 N72-21476*#
NASA-CASE-LAR-10668-1 ..... c06 N72-21103*#
NASA-CASE-LAR-10682-1 ..... c02 N72-21009*#
NASA-CASE-LAR-10726-1 ..... c14 N72-21419*#
NASA-CASE-LAR-10728-1 ..... c14 N72-21422*#
NASA-CASE-LAR-10739-1 ..... c14 N72-21424*#
NASA-CASE-LAR-10766-1 ..... c14 N72-21432*#
NASA-CASE-LAR-10776-1 ..... c02 N72-21004*#
NASA-CASE-LAR-10782-1 ..... c15 N72-21487*#
NASA-CASE-LAR-10800-1 ..... c33 N72-21955*#
NASA-CASE-LAR-10855-1 ..... c14 N72-21417*#
NASA-CASE-LAR-10953-1 ..... c17 N72-21528*#

NASA-CASE-LEW-10436-1 ..... c17 N72-21538*#
NASA-CASE-LEW-10805-2 ..... c15 N72-21485*#
NASA-CASE-LEW-11005-1 ..... c09 N72-21243*
NASA-CASE-LEW-11076-1 ..... c15 N72-21473*#

NASA-CASE-MFS-16609 ..... c14 N72-21431*#
NASA-CASE-MFS-20413 ..... c15 N72-21463*
NASA-CASE-MFS-20486 ..... c18 N72-21557*#
NASA-CASE-MFS-20642 ..... c14 N72-21407*
NASA-CASE-MFS-20698-2 ..... c15 N72-21481*#
NASA-CASE-MFS-20767 ..... c15 N72-21482*#
NASA-CASE-MFS-20781 ..... c14 N72-21429*#
NASA-CASE-MFS-20829 ..... c12 N72-21310*
NASA-CASE-MFS-20979-2 ..... c06 N72-21101*#
NASA-CASE-MFS-21214 ..... c09 N72-21252*#
NASA-CASE-MFS-21374 ..... c10 N72-21274*#
NASA-CASE-MFS-21433 ..... c09 N72-21255*#

NASA-CASE-MSC-12105-1 ..... c14 N72-21409*
NASA-CASE-MSC-13332-1 ..... c14 N72-21408*
NASA-CASE-MSC-13587 ..... c15 N72-21483*#
NASA-CASE-MSC-13932-1 ..... c08 N72-21206*#

NASA-CASE-NPO-10244 ..... c15 N72-21478*#
NASA-CASE-NPO-10440 ..... c15 N72-21466*
NASA-CASE-NPO-10679 ..... c15 N72-21462*
NASA-CASE-NPO-10743 ..... c08 N72-21199*
NASA-CASE-NPO-10832 ..... c14 N72-21405*
NASA-CASE-NPO-11001 ..... c07 N72-21118*
NASA-CASE-NPO-11018 ..... c08 N72-21200*
NASA-CASE-NPO-11103 ..... c14 N72-21406*
NASA-CASE-NPO-11134 ..... c09 N72-21246*
NASA-CASE-NPO-11264 ..... c07 N72-21155*#
NASA-CASE-NPO-11377 ..... c15 N72-21475*#
NASA-CASE-NPO-11682 ..... c15 N72-21474*#
NASA-CASE-NPO-12061-1 ..... c06 N72-21100*#

NASA-CASE-NUC-10107-1 ..... c09 N72-21254*#

NASA-CASE-XER-08476-2 ..... c26 N72-21800*#
NASA-CASE-XER-11046-2 ..... c09 N72-21251*#

NASA-CASE-XLA-10470 ..... c15 N72-21489*#
NASA-CASE-XLA-11028 ..... c15 N72-21486*#
NASA-CASE-XLA-11154 ..... c07 N72-21117*

NASA-CASE-XLE-05799 ..... c22 N72-21644*
NASA-CASE-XLE-10453-2 ..... c28 N72-21821*#

NASA-CASE-XNP-04167-3 ..... c25 N72-21693*#

NASA-CR-1949 ..... c15 N72-21479*#
NASA-CR-1961 ..... c32 N72-21933*#
NASA-CR-1974 ..... c32 N72-21932*#
NASA-CR-2000 ..... c14 N72-21412*#
NASA-CR-2010 ..... c33 N72-21954*#
NASA-CR-2025 ..... c17 N72-21534*#
NASA-CR-2033 ..... c13 N72-21365*#
NASA-CR-2035 ..... c30 N72-21870*#
NASA-CR-61376 ..... c08 N72-21202*#
NASA-CR-62079 ..... c04 N72-21041*#
NASA-CR-111940 ..... c27 N72-21809*#
NASA-CR-111997 ..... c26 N72-21798*#
NASA-CR-112023 ..... c21 N72-21625*#
NASA-CR-115494 ..... c30 N72-21858*#
NASA-CR-115508 ..... c05 N72-21074*#
NASA-CR-115511 ..... c14 N72-21426*#
NASA-CR-115512 ..... c30 N72-21860*#
NASA-CR-115513 ..... c08 N72-21204*#
NASA-CR-115514 ..... c08 N72-21205*#
NASA-CR-115515 ..... c08 N72-21203*#
NASA-CR-115524 ..... c13 N72-21356*#
NASA-CR-115525 ..... c31 N72-21892*#
NASA-CR-115531 ..... c11 N72-21288*#
NASA-CR-119992 ..... c31 N72-21886*#
NASA-CR-120035 ..... c31 N72-21888*#
NASA-CR-120040 ..... c31 N72-21889*#
NASA-CR-120824 ..... c22 N72-21645*#
NASA-CR-120825 ..... c22 N72-21647*#
NASA-CR-120874 ..... c14 N72-21428*#
NASA-CR-120880 ..... c17 N72-21526*#
NASA-CR-120891 ..... c17 N72-21529*#
NASA-CR-121087 ..... c31 N72-21883*#
NASA-CR-121088 ..... c34 N72-21967*#
NASA-CR-122364 ..... c24 N72-21675*#
NASA-CR-122375 ..... c14 N72-21410*#
NASA-CR-122377 ..... c28 N72-21820*#
NASA-CR-122379 ..... c08 N72-21207*#
NASA-CR-122382 ..... c14 N72-21427*#
NASA-CR-122389 ..... c29 N72-21831*#

NASA-CR-122398 ..... c31 N72-21895*#
NASA-CR-123487 ..... c15 N72-21468*#
NASA-CR-123488 ..... c15 N72-21467*#
NASA-CR-123541 ..... c31 N72-21884*#
NASA-CR-123543 ..... c31 N72-21882*#
NASA-CR-123544 ..... c31 N72-21880*#
NASA-CR-123545 ..... c31 N72-21881*#
NASA-CR-123564 ..... c31 N72-21878*#
NASA-CR-123569 ..... c08 N72-21201*#
NASA-CR-123593 ..... c31 N72-21879*#
NASA-CR-123595 ..... c30 N72-21857*#
NASA-CR-125929 ..... c13 N72-21354*#
NASA-CR-125930 ..... c07 N72-21154*#
NASA-CR-125931 ..... c11 N72-21281*#
NASA-CR-125932 ..... c29 N72-21828*#
NASA-CR-125933 ..... c34 N72-21968*#
NASA-CR-125934 ..... c31 N72-21885*#
NASA-CR-125935 ..... c07 N72-21120*#
NASA-CR-125936 ..... c13 N72-21355*#
NASA-CR-125937 ..... c06 N72-21097*#
NASA-CR-125938 ..... c06 N72-21096*#
NASA-CR-125978 ..... c06 N72-21095*#
NASA-CR-125979 ..... c25 N72-21690*#
NASA-CR-125980 ..... c14 N72-21411*#
NASA-CR-125981 ..... c29 N72-21829*#
NASA-CR-126024 ..... c13 N72-21358*#
NASA-CR-126025 ..... c13 N72-21357*#
NASA-CR-126032 ..... c04 N72-21050*#
NASA-CR-126033 ..... c04 N72-21049*#
NASA-CR-126034 ..... c04 N72-21048*#
NASA-CR-126035 ..... c04 N72-21047*#
NASA-CR-126036 ..... c08 N72-21208*#
NASA-CR-126037 ..... c19 N72-21568*#
NASA-CR-126038 ..... c31 N72-21891*#
NASA-CR-126039 ..... c08 N72-21210*#
NASA-CR-126040 ..... c26 N72-21720*#
NASA-CR-126041 ..... c26 N72-21727*#
NASA-CR-126042 ..... c26 N72-21742*#
NASA-CR-126043 ..... c26 N72-21748*#
NASA-CR-126044 ..... c26 N72-21764*#
NASA-CR-126045 ..... c26 N72-21791*#
NASA-CR-126047 ..... c26 N72-21793*#
NASA-CR-126140 ..... c21 N72-21633*#
NASA-CR-126246 ..... c18 N72-21555*#

NASA-SER-S-0252 ..... c31 N72-21888*#
NASA-SER-S-1049 ..... c31 N72-21889*#

NASA-SP-5905(03) ..... c15 N72-21480*#
NASA-SP-5949(01) ..... c08 N72-21209*#

NASA-TM-X-2458 ..... c12 N72-21312*#
NASA-TM-X-2511 ..... c02 N72-21005*#
NASA-TM-X-2516 ..... c01 N72-20970*#
NASA-TM-X-2522 ..... c24 N72-21677*#
NASA-TM-X-2531 ..... c01 N72-20971*#
NASA-TM-X-2533 ..... c06 N72-21098*#
NASA-TM-X-2534 ..... c22 N72-21646*#
NASA-TM-X-2537 ..... c28 N72-21817*#
NASA-TM-X-2543 ..... c17 N72-21532*#
NASA-TM-X-2545 ..... c17 N72-21527*#
NASA-TM-X-2548 ..... c17 N72-21533*#
NASA-TM-X-58088 ..... c19 N72-21567*#
NASA-TM-X-64652-VOL-1 ..... c11 N72-21282*#
NASA-TM-X-64652-VOL-2 ..... c11 N72-21283*#
NASA-TM-X-64652-VOL-3 ..... c11 N72-21284*#
NASA-TM-X-65862 ..... c31 N72-21890*#
NASA-TM-X-65864 ..... c24 N72-21676*#
NASA-TM-X-67669 ..... c11 N72-21286*#
NASA-TM-X-67680 ..... c11 N72-21285*#
NASA-TM-X-67740 ..... c11 N72-21289*#
NASA-TM-X-67741 ..... c28 N72-21819*#
NASA-TM-X-68028 ..... c17 N72-21525*#
NASA-TM-X-68031 ..... c28 N72-21816*#
NASA-TM-X-68035 ..... c03 N72-21033*#
NASA-TM-X-68036 ..... c03 N72-21034*#
NASA-TM-X-68037 ..... c33 N72-21953*#
NASA-TM-X-68038 ..... c12 N72-21311*#
NASA-TM-X-68040 ..... c11 N72-21287*#
NASA-TM-X-68043 ..... c28 N72-21815*#
NASA-TM-X-68044 ..... c33 N72-21952*#
NASA-TM-X-68047 ..... c02 N72-21001*#
NASA-TM-X-68302 ..... c07 N72-21131*#
NASA-TM-X-68303 ..... c14 N72-21905*#
NASA-TM-X-68304 ..... c17 N72-21926*#
NASA-TM-X-68305 ..... c28 N72-20983*#
NASA-TM-X-68306 ..... c02 N72-20986*#
NASA-TM-X-68851 ..... c31 N72-21894*#

NASA-TN-D-6581 ..... c23 N72-21661*#
NASA-TN-D-6676 ..... c30 N72-21863*#
NASA-TN-D-6687 ..... c25 N72-21691*#
NASA-TN-D-6691 ..... c17 N72-21537*#
NASA-TN-D-6693 ..... c18 N72-21556*#
NASA-TN-D-6740 ..... c31 N72-21887*#
NASA-TN-D-6742 ..... c13 N72-21361*#
NASA-TN-D-6746 ..... c20 N72-21589*#
NASA-TN-D-6759 ..... c12 N72-21313*#
NASA-TN-D-6760 ..... c30 N72-21859*#
NASA-TN-D-6761 ..... c15 N72-21469*#
NASA-TN-D-6765 ..... c15 N72-21470*#
NASA-TN-D-6766 ..... c01 N72-20969*#
NASA-TN-D-6774 ..... c05 N72-21075*#

NASA-TT-F-624 ..... c13 N72-21364*#
NASA-TT-F-13961 ..... c30 N72-21861*#
NASA-TT-F-13962 ..... c30 N72-21862*#
NASA-TT-F-14148 ..... c16 N72-21501*#
NASA-TT-F-14176 ..... c30 N72-21866*#
NASA-TT-F-14177 ..... c30 N72-21867*#
NASA-TT-F-14178 ..... c30 N72-21868*#
NASA-TT-F-14180 ..... c30 N72-21869*#
NASA-TT-F-14181 ..... c30 N72-21865*#
NASA-TT-F-14188 ..... c30 N72-21864*#
NASA-TT-F-14192 ..... c26 N72-21799*#
NASA-TT-F-14194 ..... c04 N72-21045*#
NASA-TT-F-14196 ..... c03 N72-21035*#
NASA-TT-F-14215 ..... c13 N72-21359*#
NASA-TT-F-14225 ..... c04 N72-21046*#
NASA-TT-F-14226 ..... c14 N72-21413*#
NASA-TT-F-14232 ..... c17 N72-21536*#
NASA-TT-F-14235 ..... c02 N72-21006*#
NASA-TT-F-14247 ..... c13 N72-21360*#
NASA-TT-F-14250 ..... c17 N72-21535*#
NASA-TT-F-14253 ..... c04 N72-21042*#
NASA-TT-F-14263 ..... c14 N72-21425*#
NASA-TT-F-14265 ..... c14 N72-21414*#

NAVMED-MF12.524.002-5012D ..... c04 N72-21067 #
NAVMED-MF12.524.004-9010D ..... c04 N72-21056 #
NAVMED-MF12.524.006-9028B ..... c04 N72-21057 #
NAVMED-MF12.524.006-9028B ..... c04 N72-21058 #
NAVMED-MF12.524.006-9028B ..... c04 N72-21059 #
NAVMED-MF12.524.015-0004B ..... c04 N72-21071 #

NBS-SP-323 ..... c26 N72-21702 #

NBS-10481 ..... c17 N72-21553 #
NBS-10624 ..... c11 N72-21305 #

NCEL-TR-742 ..... c13 N72-21395 #

NELC-TR-1782 ..... c07 N72-21175 #

NLL-LB/G/3091-(9091.9F) ..... c33 N72-21949

NLL-M-21286-(5828.4F) ..... c17 N72-21514
NLL-M-22038-(5828.4F) ..... c19 N72-21566
NLL-M-22039-(5828.4F) ..... c20 N72-21585
NLL-M-22049-(5828.4F) ..... c20 N72-21581
NLL-M-22050-(5828.4F) ..... c13 N72-21349
NLL-M-22060-(5828.4F) ..... c13 N72-21353
NLL-M-22061-(5828.4F) ..... c20 N72-21586
NLL-M-22062-(5828.4F) ..... c12 N72-21309
NLL-M-22063-(5828.4F) ..... c20 N72-21587
NLL-M-22065-(5828.4F) ..... c20 N72-21582
NLL-M-22067-(5828.4F) ..... c20 N72-21588
NLL-M-22112-(5828.4F) ..... c34 N72-21966
NLL-M-22123-(5828.4F) ..... c13 N72-21352
NLL-M-22125-(5828.4F) ..... c23 N72-21660
NLL-M-22129-(5828.4F) ..... c33 N72-21950
NLL-M-22137-(5828.4F) ..... c33 N72-21951
NLL-M-22138-(5828.4F) ..... c14 N72-21404
NLL-M-22139-(5828.4F) ..... c33 N72-21948
NLL-M-22214-(5828.4F) ..... c20 N72-21584
NLL-M-22215-(5828.4F) ..... c20 N72-21583
NLL-M-22218-(5828.4F) ..... c30 N72-21856
NLL-M-22220-(5828.4F) ..... c13 N72-21350
NLL-M-22221-(5828.4F) ..... c13 N72-21351

NLL-RTS-6710 ..... c26 N72-21699
NLL-RTS-6799 ..... c17 N72-21516
NLL-RTS-6884 ..... c06 N72-21092
NLL-RTS-6886 ..... c34 N72-21965
NLL-RTS-6925 ..... c06 N72-21093
NLL-RTS-6944 ..... c17 N72-21515
NLL-RTS-6990 ..... c12 N72-21308

NLL-TRANS-746-1099-(9022.401) ..... c06 N72-21091
NLL-TRANS-2818-(9022.81) ..... c26 N72-21700

NLR-MP-70015-U ..... c01 N72-20972 #

NMAB-2-C ..... c17 N72-21551 #

NNCSSC-SPH-OCD-66A-70 ..... c34 N72-21982 #

NOLTR-71-139 ..... c12 N72-21324 #
NOLTR-71-187 ..... c18 N72-21563 #
NOLTR-71-210 ..... c16 N72-21509 #

NOO-IR-71-10 ..... c13 N72-21389 #

NOTA-INTERNA-328 ..... c24 N72-21683 #
NOTA-INTERNA-332 ..... c24 N72-21684 #
NOTA-INTERNA-336 ..... c24 N72-21689 #
NOTA-INTERNA-338 ..... c24 N72-21688 #
NOTA-INTERNA-342 ..... c24 N72-21687 #
NOTA-INTERNA-343 ..... c24 N72-21686 #
NOTA-INTERNA-344-PT-1 ..... c24 N72-21685 #

NP-19112 ..... c22 N72-21649 #
NP-19129 ..... c24 N72-21682 #

NPS-51ES/NR71121A ..... c13 N72-21393 #

NRC-TR-71-500 ..... c15 N72-21493 #

NRC-12285 ..... c02 N72-21014 #
NRC-12370 ..... c11 N72-21307 #

NREC-1168-1 ..... c02 N72-21017 #

NRL-MR-2369 ..... c22 N72-21659 #

NRL-7337 ..... c04 N72-21068 #

NSMRL-652 ..... c04 N72-21057 #
NSMRL-661 ..... c04 N72-21058 #
NSMRL-662 ..... c04 N72-21059 #

NSRDC-3716 ..... c32 N72-21944 #
NSRDC-3751 ..... c32 N72-21943 #

NTSB-AAR-71-15 ..... c02 N72-21020 #
NTSB-AAR-72-2 ..... c02 N72-21003 #
NTSB-AAR-72-3 ..... c02 N72-21002 #

NTSB-AAM-71-7 ..... c02 N72-21025 #
NTSB-AAM-71-8 ..... c02 N72-21024 #
NTSB-AAM-71-9 ..... c02 N72-21026 #
NTSB-AAM-71-10 ..... c02 N72-21022 #
NTSB-AAM-71-11 ..... c02 N72-21021 #
NTSB-AAM-71-12 ..... c02 N72-21023 #

NUC-TP-239 ..... c16 N72-21505 #
NUC-TP-266 ..... c13 N72-21378 #

NVO-1163-227 ..... c13 N72-21371 #
NVO-1163-228 ..... c13 N72-21369 #

NYO-3246-TA-9 ..... c14 N72-21440 #
NYO-3829-75 ..... c24 N72-21678 #

OACSI-J-9802 ..... c15 N72-21495 #

ONR-17-REV ..... c34 N72-21979 #
ONR-71-1 ..... c02 N72-21027 #
ONR-71-3 ..... c14 N72-21456 #

ONRL-R-46-71 ..... c20 N72-21605 #

ORNL-TM-2959 ..... c33 N72-21958 #
ORNL-TM-2961 ..... c22 N72-21655 #
ORNL-TM-3370 ..... c14 N72-21438 #
ORNL-TM-3455 ..... c06 N72-21096*#
ORNL-TM-3639 ..... c22 N72-21654 #

ORNL-4625 ..... c17 N72-21541 #
ORNL-4633 ..... c22 N72-21648 #
ORNL-4739 ..... c06 N72-21108 #

ORO-3622-12-PT-1 ..... c13 N72-21366 #
ORO-3651-10 ..... c24 N72-21679 #

OSW-PR-703 ..... c33 N72-21960 #

P-514 ..... c11 N72-21290 #

PA-TR-4261 ..... c18 N72-21564 #

PB-202053-F ..... c11 N72-21285*#
PB-202055-F ..... c11 N72-21286*#
PB-203059-F ..... c11 N72-21289*#
PB-204183 ..... c09 N72-21259 #
PB-204595 ..... c07 N72-21190 #
PB-204619 ..... c33 N72-21960 #
PB-204710 ..... c01 N72-20975 #
PB-204793 ..... c14 N72-21452 #
PB-204794 ..... c20 N72-21592 #
PB-204799 ..... c07 N72-21165 #
PB-204801 ..... c34 N72-21977 #
PB-204802 ..... c21 N72-21634 #
PB-204803 ..... c34 N72-21978 #
PB-204805 ..... c14 N72-21451 #
PB-204806 ..... c14 N72-21449 #
PB-204808 ..... c14 N72-21448 #
PB-204809 ..... c14 N72-21447 #
PB-204810 ..... c14 N72-21450 #
PB-204811 ..... c02 N72-21025 #
PB-204812 ..... c02 N72-21024 #
PB-204859 ..... c34 N72-21990 #
PB-204860 ..... c07 N72-21191 #
PB-204862 ..... c21 N72-21642 #
PB-204878 ..... c02 N72-21017 #
PB-204920 ..... c02 N72-21018 #
PB-204926 ..... c02 N72-21026 #
PB-204939 ..... c20 N72-21609 #
PB-204989 ..... c20 N72-21598 #
PB-204991 ..... c02 N72-21023 #
PB-205013 ..... c34 N72-21983 #
PB-205029 ..... c09 N72-21265 #
PB-205091 ..... c04 N72-21070 #
PB-205096 ..... c02 N72-21022 #
PB-205097 ..... c02 N72-21021 #
PB-205189 ..... c14 N72-21457 #
PB-205250 ..... c02 N72-21020 #
PB-205254 ..... c03 N72-21039 #
PB-205260 ..... c13 N72-21396 #
PB-205277-F ..... c20 N72-21599 #
PB-205279 ..... c14 N72-21458 #
PB-205311 ..... c19 N72-21575 #
PB-205312 ..... c19 N72-21576 #
PB-205474 ..... c05 N72-21086 #
PB-205504 ..... c30 N72-21877 #

PH-43-68-1455-3 ..... c05 N72-21086 #

PIBMRI-R-452.36.-71 ..... c23 N72-21673 #

PPG-96 ..... c13 N72-21354*#
PPG-104 ..... c13 N72-21382 #

PR-2 ..... c32 N72-21946 #
PR-36 ..... c23 N72-21673 #

PRRL-71-CR-36 ..... c09 N72-21267 #

PSU-IRL-SCI-378 ..... c13 N72-21386 #

QPR-4 ..... c23 N72-21672 #

QR-FY71-4 ..... c09 N72-21256 #

QR-3 ..... c17 N72-21539 #
QR-5 ..... c18 N72-21555*#
QR-9 ..... c09 N72-21267 #

R-ILC-71-29 ..... c23 N72-21666 #

R-540 ..... c08 N72-21232 #
R-774-PR ..... c20 N72-21602 #
R-844-PR ..... c34 N72-21985 #
R-4646-2 ..... c27 N72-21814 #

RAC-TECH-MONO-71-1 ..... c09 N72-21261 #

RAC-0-3-R16 ..... c07 N72-21163 #

RADC-TR-71-235 ..... c08 N72-21241 #
RADC-TR-71-241 ..... c09 N72-21263 #
RADC-TR-71-242 ..... c32 N72-21940 #
RADC-TR-71-255 ..... c07 N72-21167 #
RADC-TR-71-271 ..... c23 N72-21668 #
RADC-TR-71-287 ..... c07 N72-21182 #

RADC-TR-71-313 ..... c12 N72-21328 #
RADC-TR-71-314 ..... c16 N72-21512 #

RAE-LIB-TRANS-1585 ..... c32 N72-21934 #
RAE-LIB-TRANS-1611 ..... c04 N72-21051 #
RAE-LIB-TRANS-1620 ..... c10 N72-21273 #
RAE-LIB-TRANS-1634 ..... c13 N72-21363 #

RD/B/W-1962-PT-1 ..... c08 N72-21228 #

REPT-3 ..... c04 N72-21064 #
REPT-3WWTW-71-3 ..... c20 N72-21616 #
REPT-5WWTW-72-1 ..... c20 N72-21614 #
REPT-6-71 ..... c05 N72-21082 #
REPT-15-15 ..... c20 N72-21609 #
REPT-19 ..... c06 N72-21097*#
REPT-71-F ..... c04 N72-21062 #
REPT-71-WA/HGT-1 ..... c34 N72-21984 #
REPT-71-02191 ..... c24 N72-21675*#
REPT-72-08 ..... c07 N72-21171 #
REPT-72-0005-VOL-3 ..... c08 N72-21201*#
REPT-1891 ..... c26 N72-21801 #
REPT-1891 ..... c26 N72-21801 #
REPT-1971-15 ..... c29 N72-21854 #
REPT-1971-16 ..... c29 N72-21853 #
REPT-2075-1 ..... c02 N72-21012 #
REPT-08635-1-F ..... c20 N72-21603 #
REPT-12233-FR ..... c14 N72-21426*#

RES-PAPER-P-514 ..... c11 N72-21290 #

RIPP-142 ..... c29 N72-21830 #

RLO-2229-T-4-1 ..... c13 N72-21367 #

RM-528J ..... c32 N72-21942 #
RM-530 ..... c19 N72-21580 #
RM-532J ..... c14 N72-21460 #
RM-538 ..... c06 N72-21104 #
RM-6200/10-PR ..... c10 N72-21278 #

RPI-3820-5 ..... c17 N72-21545 #

RR-262 ..... c19 N72-21572 #

RSC-22 ..... c13 N72-21357*#
RSC-36 ..... c13 N72-21358*#

SACLANTCEN-TR-174 ..... c13 N72-21390 #

SAM-CR-71-3 ..... c05 N72-21083 #

SAM-TR-71-48 ..... c04 N72-21066 #
SAM-TR-72-2 ..... c05 N72-21087 #

SAMSO-TR-71-152 ..... c30 N72-21876 #
SAMSO-TR-71-314 ..... c07 N72-21194 #
SAMSO-TR-71-318 ..... c29 N72-21855 #
SAMSO-TR-71-320 ..... c13 N72-21400 #
SAMSO-TR-71-321 ..... c13 N72-21403 #
SAMSO-TR-71-322 ..... c16 N72-21510 #
SAMSO-TR-71-329 ..... c13 N72-21397 #
SAMSO-TR-71-331 ..... c16 N72-21508 #

SAO-SPECIAL-REPT-338 ..... c29 N72-21829*#

SATR-8 ..... c07 N72-21188 #

SC-T-713086 ..... c14 N72-21437 #

SCL-DR-710094 ..... c10 N72-21277 #

SD-70-556-2-VOL-2 ..... c15 N72-21467*#
SD-70-557-7-VOL-7 ..... c15 N72-21468*#

SDC-TM-4786/000/00 ..... c08 N72-21208*#
SDC-TM-4857/001/00 ..... c07 N72-21184 #
SDC-TM-4857/200/00 ..... c07 N72-21185 #

SIO-REP-71-19 ..... c13 N72-21391 #

SM-15 ..... c13 N72-21392 #

SR-1 ..... c20 N72-21600 #
SR-3 ..... c07 N72-21169 #

SRD-72-016 ..... c16 N72-21513 #

SSL-SER-12-ISSUE-99 ..... c13 N72-21377 #

STU-68-261-U-208 ..... c17 N72-21542 #

SU-CS-71-238 ..... c10 N72-21280 #

SU-RSL-71-6 ..... c13 N72-21356*#

SU-SEL-71-033 ..... c05 N72-21088 #
SU-SEL-71-051 ..... c10 N72-21280 #

SU-TR-18 ..... c12 N72-21327 #
SU-TR-6792-2 ..... c05 N72-21088 #

SWRI-RS-579 ..... c27 N72-21813 #

TAE-139 ..... c32 N72-21947 #

TASC-TR-170-3 ..... c31 N72-21899 #

TECH-PAPER-1100-71-1 ..... c21 N72-21635 #

TE4100-6-72 ..... c05 N72-21086 #

THEMIS-UGA-16 ..... c08 N72-21233 #

THEMIS-15 ..... c19 N72-21577 #

TID-25783 ..... c17 N72-21539 #

TM-72-1022-2 ..... c21 N72-21633*#

TN-1971-49 ..... c07 N72-21186 #

TR-2 ..... c07 N72-21195 #
TR-2 ..... c15 N72-21500 #
TR-2 ..... c17 N72-21529*#
TR-3 ..... c12 N72-21328 #
TR-4 ..... c06 N72-21116 #
TR-5 ..... c13 N72-21401 #
TR-5 ..... c14 N72-21453 #
TR-8 ..... c26 N72-21803 #
TR-12-72-VOL-1 ..... c08 N72-21204*#
TR-12-72-VOL-2 ..... c08 N72-21205*#
TR-17 ..... c10 N72-21280 #
TR-22 ..... c26 N72-21803 #
TR-28 ..... c17 N72-21550 #
TR-33 ..... c33 N72-21964 #
TR-56 ..... c10 N72-21279 #
TR-58 ..... c15 N72-21498 #
TR-69 ..... c19 N72-21577 #
TR-72-10 ..... c04 N72-21047*#
TR-72-11 ..... c04 N72-21048*#
TR-72-14 ..... c04 N72-21050*#
TR-72-15 ..... c04 N72-21049*#
TR-72-15-AD ..... c02 N72-21013 #
TR-74 ..... c08 N72-21233 #
TR-98 ..... c05 N72-21082 #
TR-107 ..... c04 N72-21061 #
TR-111 ..... c23 N72-21670 #
TR-143 ..... c07 N72-21169 #
TR-241-1053 ..... c30 N72-21870*#
TR-249 ..... c32 N72-21940 #
TR-482 ..... c13 N72-21387 #
TR-484 ..... c09 N72-21264 #
TR-486 ..... c07 N72-21193 #
TR-0172(2230-20)-7 ..... c30 N72-21876 #
TR-0172(2260-10)-5 ..... c13 N72-21400 #
TR-0172(2260-10)-8 ..... c13 N72-21397 #
TR-0172(2260-20)-11 ..... c29 N72-21855 #
TR-0172(2260-20)-12 ..... c13 N72-21403 #
TR-0172(2310)-1 ..... c07 N72-21194 #
TR-0172(2311)-1 ..... c16 N72-21510 #
TR-0172(9230-10)-13 ..... c16 N72-21508 #
TR-0913A ..... c21 N72-21625*#

TRITA-EPP-72-02 ..... c29 N72-21851 #

TRW-ER-7451 ..... c17 N72-21529*#

TRW-06818-W032-R000 ..... c09 N72-21265 #
TRW-07126-6010-R000 ..... c06 N72-21113 #
TRW-09865-6002-R000 ..... c29 N72-21852 #
TRW-14103-6003-R000 ..... c14 N72-21457 #
TRW-20266-6010-R000 ..... c28 N72-21820*#

U-OF-IOWA-72-2 ..... c29 N72-21828*#

UCRL-51089 ..... c12 N72-21318 #
UCRL-51090 ..... c30 N72-21872 #

UCRL-51103 ..... c25 N72-21695 #
UCRL-73478 ..... c16 N72-21504 #
UCRL-73495 ..... c19 N72-21571 #

UCSESM-71-4 ..... c32 N72-21936 #
UCSESM-71-7 ..... c32 N72-21938 #

UHMET-71-04 ..... c20 N72-21600 #

UILU-ENG-71-2243 ..... c08 N72-21232 #

UMTA-TRD-73-71-2 ..... c34 N72-21983 #

UR-72-00014 ..... c31 N72-21878*#

US-PATENT-APPL-SN-3654 ..... c14 N72-21406*
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US-PATENT-APPL-SN-15024 ..... c09 N72-21245*
US-PATENT-APPL-SN-22265 ..... c14 N72-21405*
US-PATENT-APPL-SN-23532 ..... c07 N72-21117*
US-PATENT-APPL-SN-25487 ..... c08 N72-21197*
US-PATENT-APPL-SN-31703 ..... c09 N72-21244*
US-PATENT-APPL-SN-36531 ..... c07 N72-21155*#
US-PATENT-APPL-SN-39755 ..... c08 N72-21198*
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US-PATENT-APPL-SN-45549 ..... c06 N72-21100*#
US-PATENT-APPL-SN-60197 ..... c26 N72-21800*#
US-PATENT-APPL-SN-61894 ..... c12 N72-21310*
US-PATENT-APPL-SN-69209 ..... c15 N72-21463*
US-PATENT-APPL-SN-71047 ..... c09 N72-21247*
US-PATENT-APPL-SN-77169 ..... c14 N72-21408*
US-PATENT-APPL-SN-82279 ..... c14 N72-21431*#
US-PATENT-APPL-SN-84212 ..... c18 N72-21557*#
US-PATENT-APPL-SN-86548 ..... c09 N72-21243*
US-PATENT-APPL-SN-87597 ..... c09 N72-21251*#
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US-PATENT-APPL-SN-127915 ..... c02 N72-21009*#
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US-PATENT-APPL-SN-136086 ..... c15 N72-21481*#
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US-PATENT-APPL-SN-146935 ..... c14 N72-21419*#
US-PATENT-APPL-SN-147103 ..... c10 N72-21275*#
US-PATENT-APPL-SN-149983 ..... c31 N72-21893*#
US-PATENT-APPL-SN-154094 ..... c33 N72-21955*#
US-PATENT-APPL-SN-154933 ..... c14 N72-21434*#
US-PATENT-APPL-SN-159857 ..... c05 N72-21079*#
US-PATENT-APPL-SN-162380 ..... c16 N72-21503*#
US-PATENT-APPL-SN-163151 ..... c23 N72-21663*#
US-PATENT-APPL-SN-163152 ..... c17 N72-21528*#
US-PATENT-APPL-SN-166541 ..... c14 N72-21417*#
US-PATENT-APPL-SN-168650 ..... c14 N72-21435*#
US-PATENT-APPL-SN-170544 ..... c25 N72-21693*#
US-PATENT-APPL-SN-172459 ..... c06 N72-21103*#
US-PATENT-APPL-SN-180473 ..... c28 N72-21821*#
US-PATENT-APPL-SN-180962 ..... c14 N72-21433*#
US-PATENT-APPL-SN-182033 ..... c33 N72-21956*#
US-PATENT-APPL-SN-182978 ..... c16 N72-21502*#
US-PATENT-APPL-SN-187262 ..... c15 N72-21475*#
US-PATENT-APPL-SN-187365 ..... c15 N72-21474*#
US-PATENT-APPL-SN-188836 ..... c14 N72-21432*#
US-PATENT-APPL-SN-191301 ..... c06 N72-21099*#
US-PATENT-APPL-SN-193672 ..... c05 N72-21076*#
US-PATENT-APPL-SN-196898 ..... c15 N72-21482*#
US-PATENT-APPL-SN-197689 ..... c15 N72-21487*#
US-PATENT-APPL-SN-197870 ..... c14 N72-21423*#
US-PATENT-APPL-SN-198472 ..... c06 N72-21102*#
US-PATENT-APPL-SN-198743 ..... c15 N72-21484*#
US-PATENT-APPL-SN-198928 ..... c15 N72-21477*#
US-PATENT-APPL-SN-201700 ..... c09 N72-21254*#
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US-PATENT-APPL-SN-202750 ..... c14 N72-21416*#
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US-PATENT-APPL-SN-206698 ..... c15 N72-21483*#
US-PATENT-APPL-SN-209145 ..... c14 N72-21429*#
US-PATENT-APPL-SN-209618 ..... c10 N72-21276*#
US-PATENT-APPL-SN-212028 ..... c09 N72-21249*#
US-PATENT-APPL-SN-212921 ..... c07 N72-21160*#
US-PATENT-APPL-SN-213949 ..... c07 N72-21159*#
US-PATENT-APPL-SN-214084 ..... c15 N72-21476*#
US-PATENT-APPL-SN-214086 ..... c14 N72-21415*#
US-PATENT-APPL-SN-217213 ..... c15 N72-21471*#
US-PATENT-APPL-SN-219435 ..... c15 N72-21486*#
US-PATENT-APPL-SN-219436 ..... c15 N72-21489*#

US-PATENT-APPL-SN-219590 ..... c06 N72-21101*#
US-PATENT-APPL-SN-219722 ..... c21 N72-21631*#
US-PATENT-APPL-SN-221093 ..... c17 N72-21538*#
US-PATENT-APPL-SN-221332 ..... c02 N72-21004*#
US-PATENT-APPL-SN-221670 ..... c14 N72-21421*#
US-PATENT-APPL-SN-221685 ..... c15 N72-21472*#
US-PATENT-APPL-SN-221833 ..... c09 N72-21253*#
US-PATENT-APPL-SN-228109 ..... c23 N72-21662*#
US-PATENT-APPL-SN-229128 ..... c14 N72-21418*#
US-PATENT-APPL-SN-229143 ..... c09 N72-21248*#
US-PATENT-APPL-SN-229354 ..... c08 N72-21206*#
US-PATENT-APPL-SN-229413 ..... c14 N72-21420*#
US-PATENT-APPL-SN-232021 ..... c21 N72-21632*#
US-PATENT-APPL-SN-233743 ..... c15 N72-21485*#
US-PATENT-APPL-SN-235269 ..... c09 N72-21252*#
US-PATENT-APPL-SN-236281 ..... c09 N72-21255*#
US-PATENT-APPL-SN-238047 ..... c10 N72-21274*#
US-PATENT-APPL-SN-238264 ..... c15 N72-21473*#
US-PATENT-APPL-SN-756834 ..... c15 N72-21466*
US-PATENT-APPL-SN-763743 ..... c14 N72-21409*
US-PATENT-APPL-SN-796690 ..... c07 N72-21119*
US-PATENT-APPL-SN-825258 ..... c26 N72-21701*
US-PATENT-APPL-SN-833049 ..... c06 N72-21094*
US-PATENT-APPL-SN-848282 ..... c15 N72-21462*
US-PATENT-APPL-SN-850587 ..... c08 N72-21199*
US-PATENT-APPL-SN-856279 ..... c07 N72-21118*
US-PATENT-APPL-SN-873259 ..... c08 N72-21200*
US-PATENT-APPL-SN-873793 ..... c14 N72-21407*
US-PATENT-APPL-SN-883524 ..... c09 N72-21246*
US-PATENT-APPL-SN-889551 ..... c21 N72-21624*
US-PATENT-APPL-SN-889583 ..... c15 N72-21464*

US-PATENT-CLASS-23-253R ..... c15 N72-21465*
US-PATENT-CLASS-23-259 ..... c15 N72-21465*
US-PATENT-CLASS-73-84 ..... c14 N72-21406*
US-PATENT-CLASS-73-141A ..... c14 N72-21405*
US-PATENT-CLASS-73-147 ..... c14 N72-21407*
US-PATENT-CLASS-73-425.6 ..... c15 N72-21465*
US-PATENT-CLASS-74-89.15 ..... c15 N72-21462*
US-PATENT-CLASS-74-469 ..... c15 N72-21463*
US-PATENT-CLASS-96-36.2 ..... c06 N72-21094*
US-PATENT-CLASS-141-23 ..... c15 N72-21465*
US-PATENT-CLASS-156-3 ..... c06 N72-21094*
US-PATENT-CLASS-169-28 ..... c12 N72-21310*
US-PATENT-CLASS-169-36 ..... c12 N72-21310*
US-PATENT-CLASS-176-86L ..... c22 N72-21644*
US-PATENT-CLASS-179-100.2K ..... c07 N72-21119*
US-PATENT-CLASS-195-127 ..... c15 N72-21465*
US-PATENT-CLASS-204-59 ..... c15 N72-21466*
US-PATENT-CLASS-204-130 ..... c15 N72-21466*
US-PATENT-CLASS-222-71 ..... c15 N72-21465*
US-PATENT-CLASS-222-135 ..... c15 N72-21465*
US-PATENT-CLASS-222-309 ..... c15 N72-21465*
US-PATENT-CLASS-235-155 ..... c08 N72-21197*
US-PATENT-CLASS-244-1SA ..... c21 N72-21624*
US-PATENT-CLASS-250.43.5R ..... c14 N72-21408*
US-PATENT-CLASS-250-83.3H ..... c14 N72-21408*
US-PATENT-CLASS-307-230 ..... c09 N72-21245*
US-PATENT-CLASS-307-257 ..... c09 N72-21247*
US-PATENT-CLASS-307-259 ..... c09 N72-21247*
US-PATENT-CLASS-307-295 ..... c09 N72-21245*
US-PATENT-CLASS-307-299 ..... c08 N72-21196*
US-PATENT-CLASS-307-299 ..... c26 N72-21701*
US-PATENT-CLASS-307-303 ..... c08 N72-21198*
US-PATENT-CLASS-307-311 ..... c08 N72-21198*
US-PATENT-CLASS-317-234V ..... c26 N72-21701*
US-PATENT-CLASS-317-235R ..... c26 N72-21701*
US-PATENT-CLASS-318-576 ..... c09 N72-21246*
US-PATENT-CLASS-323-DIG.1 ..... c09 N72-21243*
US-PATENT-CLASS-323-22T ..... c09 N72-21243*
US-PATENT-CLASS-323-38 ..... c09 N72-21243*
US-PATENT-CLASS-324-57R ..... c15 N72-21464*
US-PATENT-CLASS-324-64 ..... c15 N72-21464*
US-PATENT-CLASS-324-71R ..... c09 N72-21246*
US-PATENT-CLASS-324-71R ..... c15 N72-21464*
US-PATENT-CLASS-328-142 ..... c09 N72-21245*
US-PATENT-CLASS-328-167 ..... c09 N72-21245*
US-PATENT-CLASS-330-70R ..... c09 N72-21245*
US-PATENT-CLASS-330-85 ..... c09 N72-21245*
US-PATENT-CLASS-331-14 ..... c09 N72-21247*
US-PATENT-CLASS-331-23 ..... c09 N72-21247*
US-PATENT-CLASS-331-30 ..... c09 N72-21247*
US-PATENT-CLASS-331-107 ..... c26 N72-21701*
US-PATENT-CLASS-331-111 ..... c09 N72-21247*
US-PATENT-CLASS-332-31 ..... c26 N72-21701*
US-PATENT-CLASS-333-80 ..... c09 N72-21245*
US-PATENT-CLASS-340-173.2 ..... c08 N72-21198*
US-PATENT-CLASS-340-173LS ..... c08 N72-21198*
US-PATENT-CLASS-340-174CS ..... c08 N72-21199*

US-PATENT-CLASS-340-174LC ..... c08 N72-21199*
US-PATENT-CLASS-340-174M ..... c08 N72-21199*
US-PATENT-CLASS-340-174SR ..... c08 N72-21199*
US-PATENT-CLASS-340-347AD ..... c08 N72-21200*
US-PATENT-CLASS-340-347DD ..... c08 N72-21197*
US-PATENT-CLASS-343-5CM ..... c07 N72-21118*
US-PATENT-CLASS-343-6.5R ..... c07 N72-21118*
US-PATENT-CLASS-343-100ST ..... c07 N72-21118*
US-PATENT-CLASS-343-706 ..... c07 N72-21117*
US-PATENT-CLASS-343-771 ..... c09 N72-21244*
US-PATENT-CLASS-343-893 ..... c09 N72-21244*
US-PATENT-CLASS-343-912 ..... c07 N72-21117*
US-PATENT-CLASS-346-1 ..... c09 N72-21246*
US-PATENT-CLASS-346-29 ..... c09 N72-21246*
US-PATENT-CLASS-356-17 ..... c14 N72-21409*
US-PATENT-CLASS-356-18 ..... c14 N72-21409*

US-PATENT-3,613,110 ..... c08 N72-21199*
US-PATENT-3,613,111 ..... c08 N72-21200*
US-PATENT-3,613,794 ..... c12 N72-21310*
US-PATENT-3,614,228 ..... c14 N72-21409*
US-PATENT-3,614,343 ..... c07 N72-21119*
US-PATENT-3,614,431 ..... c14 N72-21408*
US-PATENT-3,614,557 ..... c26 N72-21701*
US-PATENT-3,614,648 ..... c09 N72-21247*
US-PATENT-3,614,898 ..... c15 N72-21462*
US-PATENT-3,615,241 ..... c15 N72-21465*
US-PATENT-3,615,465 ..... c06 N72-21094*
US-PATENT-3,616,338 ..... c15 N72-21466*
US-PATENT-3,620,095 ..... c15 N72-21463*
US-PATENT-3,621,407 ..... c09 N72-21245*
US-PATENT-3,623,030 ..... c08 N72-21198*
US-PATENT-3,623,107 ..... c07 N72-21117*
US-PATENT-3,623,359 ..... c14 N72-21406*
US-PATENT-3,623,360 ..... c14 N72-21405*
US-PATENT-3,623,361 ..... c14 N72-21407*
US-PATENT-3,624,241 ..... c22 N72-21644*
US-PATENT-3,624,496 ..... c15 N72-21464*
US-PATENT-3,624,650 ..... c07 N72-21118*
US-PATENT-3,624,659 ..... c09 N72-21246*
US-PATENT-3,637,170 ..... c21 N72-21624*
US-PATENT-3,638,002 ..... c08 N72-21197*
US-PATENT-3,638,103 ..... c09 N72-21243*
US-PATENT-3,638,224 ..... c09 N72-21244*

USAARL-72-5 ..... c02 N72-21016 #

USAMRL-947 ..... c04 N72-21072 #

USGS-GD-71-030 ..... c13 N72-21396 #

VPI-E-71-23 ..... c01 N72-20975 #

V6803 ..... c17 N72-21534*#

WANL-PR(WWW)-11 ..... c22 N72-21647*#

WANL-4219-1 ..... c22 N72-21656 #

WC-5 ..... c13 N72-21401 #

WHOI-REF-71-66 ..... c13 N72-21374 #
WHOI-REF-71-68 ..... c13 N72-21375 #
WHOI-REF-71-70 ..... c23 N72-21671 #

WIS-TCI-462 ..... c06 N72-21095*#

WVT-7145 ..... c32 N72-21939 #
WVT-7153 ..... c17 N72-21549 #

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ZJE-111 ..... c22 N72-21651 #

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